Network Coding Based Reliable Content Delivery in VANET

Smita Solanki[1], Yagyapal Yadav[2]
[1, 2] Dept of Computer Science and Engineering
[1, 2] IES-IPSA, Indore, India

Abstract- *Vehicular ad hoc networks (VANETs) carry information public in nature, which benefits most of the vehicular nodes involved. Therefore broadcasting data becomes a natural choice for disseminating data in VANETs. Broadcasting also offers advantages of simplicity and flexibility, by virtue of not requiring knowledge of the actual network topology. Vehicular unintentional Network (VANET) could be a quite special wireless unintentional network, that has the characteristics of high node quality and quick topology changes therefore the content distribution in VANET is extremely troublesome due to the quick topology changes and additionally VANET has exterior medium for causation the packet information, therefore there's less responsibility in content distribution whereas victimization broadcasting protocol.. So in our strategy we have proposed random linear network coding for encoding two or more packets. Our proposed protocol will provide better reliability and we will compare and analyze our protocol for throughput, end to end delay and packet delivery ratio.*

Keywords- VANET; broadcasting; victimization; protocol; throughput; packet delivery ratio

I. INTRODUCTION

Vehicular Ad hoc Network (VANET) is a subset of Mobile Ad hoc Networks (MANET), which forms wireless networks between vehicles and where each vehicle acts as a router to communicate with other vehicle. Vehicular Ad hoc network is one of the promising research areas in wireless networks. VANETs integrate the features of Ad hoc network, Wireless and cellular technology to achieve intelligent transport systems by communicating between vehicle to vehicle or vehicle to RSUs. This is mainly due to DSRC (Dedicated Short Range Communications) standardization which enables vehicles and road side units to form VANETs.
The Vehicle Ad hoc network is defined as a fast moving outdoor communication network, also known as SOTIS (self-organizing traffic information system). In VANET, the moving vehicles can constitute a network communication by exchanging the speed and position information for another. Each node in the network has the ability to find the path, which adopted the multi-hop to deliver the information sent out from the source node finally to the destination node place through a series of forwarding. The network communication is made up of two parts: vehicle to vehicle (V2V) communication and vehicle to infrastructure (V2I) communication.

VANET routing is classified into:-

- Unicast: Vehicle to Vehicle communication
- Multicast: Vehicle to multicast members through multi hop communication
- Geocast: A subset of Multicast with communication targeted in a specific geographical location Broadcast: Vehicle to all the vehicles in the coverage area.
- The existing VANET routing protocol can be roughly divided into three categories:
- TBR, topology-based routing
- PBR, position-based routing
- Hybrid routing

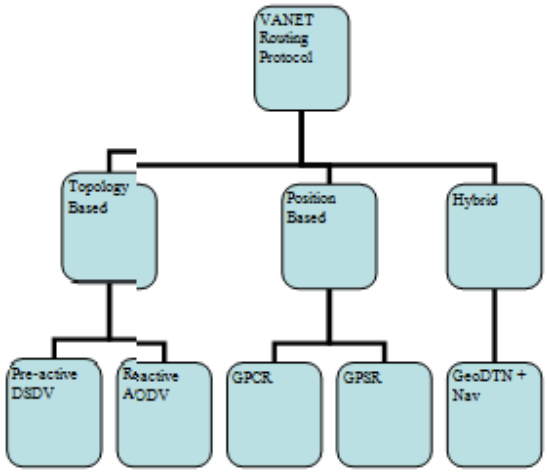

Figure 1 A Turing Machine with Advice

II. COMMUNICATION IN VANET

Information dissemination is very important in a VANET environment. Routing plays a vital role in information dissemination. By using Network coding we can improve the reliability of routing protocol in VANET.

Communication networks nowadays share identical fundamentals of operation. Whether or not it's packets over the net, or signals in a very phone network, data is transported within the same means as cars share a road or fluids share pipes. That is, freelance information streams could share network resources, however the knowledge itself is separate. Routing, information storage, error management, and usually all network functions area unit supported this assumption. Network secret writing may be a recent field in scientific theory that breaks with this assumption. Rather than merely forwarding information, nodes could recombine many input packets into one or many output packets.

Linear network cryptography, in general, is comparable to the present example, with the distinction that the xor operation is replaced by a linear combination of the information, understood as numbers over some finite field. This enables for means far larger degree of flexibility within the way packets are often combined. Additionally to the outturn advantages proved during this example, network cryptography is additionally all right suited to environments wherever solely partial or unsure data out there for higher cognitive process. Like erasure cryptography, sure-fire reception of data doesn't rely upon receiving specific packet content however rather on receiving an adequate variety of freelance packets.

If we tend to linearly mix packets of length L, the ensuing encoded packet additionally has size L. In distinction to concatenation, every encoded packet contains solely a fraction of the data contained in original packets. One will think about linear network cryptography as a variety of data spreading. This encompasses a profit in several cases

Random network cryptography may be a straightforward nonetheless powerful secret writing theme, that in broadcast transmission schemes permits near best outturn employing a decentralized rule. Nodes transmit random linear combos of the packets they receive, with coefficients chosen from a Galois field.

III. PROBLEMS IN VANET

Unlike in MANET, the mobility of vehicles in VANET is constrained by predefined roads, such as a network of highways and city. Therefore, the routing protocol in MANET cannot be used in VANET directly; to design a suitable routing in VANET becomes an important Issue. Because of the high mobility of nodes and rapid changes of topology, designing an efficient routing protocol that can deliver a packet in a minimum period of time with few dropped packets is considered to be a critical challenge in VANET. Below are key challenges observed in VANET:-

a. Signal Fading

Objects placed as obstacles between two communicating vehicles are one of the challenges that can affect the efficiency of VANET; these obstacles can be other vehicles or buildings distributed along roads especially in the cities.

b. Bandwidth Limitations

Another key issue in the VANET is the absence of a central coordinator that controls the communications between nodes, and which has the responsibility of managing the bandwidth and contention operation. Therefore it is necessary to utilize the availability of bandwidth efficiently. There is a high probability that channel congestion can occur, owing to the limited range of bandwidth frequency (10–20 MHz) for VANET applications, particularly in a high density environment. The fair use of bandwidth has its impact on reducing the time delay for disseminating messages.

c. Connectivity

Owing to the high mobility and rapid changes of topology, which lead to a frequent fragmentation in networks.

d. Small Effective Diameter

Owing to the small effective network diameter of a VANET, that leads to a weak connectivity in the communication between nodes. Therefore, maintaining the complete global topology of the network is impracticable for a node. The restricted effective diameter results in problems when applying existing routing algorithms to a VANET.

e. Security and Privacy

Keeping a reasonable balance between the security and privacy is one of the main challenges in VANET; the receipt of trustworthy information from its source is important for the receiver.

f. Routing Protocol

Because of the high mobility of nodes and rapid changes of topology, designing an efficient routing protocol that can deliver a packet in a minimum period of time with few dropped packets is considered to be a critical challenge in VANET. Furthermore, many researchers have concentrated on

designing a routing protocol suitable for dense environments that have a high density of vehicles with close distances between them. Designing an efficient routing protocol has an impact on improving many factors; the first of these is enhancing the reliability of the system by leveraging the percentage of packets delivery.

IV. EXISTING CODING TECHNIQUES IN VANET

This section describes the studies which has been done in this direction:-

a. Paper 1 :- A Survey of Routing Protocols for VANET in Urban Scenarios

Author - P. S. Nithya Darisini, N. Santhiya Kumari

Conference/ Journal – Proceedings of the 2013 International Conference on Pattern

Recognition, Informatics and Mobile Engineering (PRIME) February 21-22, 2013 IEEE.

Summary:-

This paper focuses on the survey of various routing protocols [ASTAR (Anchor based street and Traffic Aware Routing), CAR (Connectivity Aware Routing), RBVT (Road based using vehicular traffic information), CLWPR (Cross layer weighted position based routing), GeoSVR (Geographic Stateless VANET routing protocol)) proposed for VANETs in city environments. The advantages and disadvantages of the surveyed protocols are described and the same have been analyzed in terms of packet delivery ratio, end to end delay and latency.

A-STAR (Anchor-based Street and Traffic Aware Routing):

- First proposed to use buses as anchors for measuring the connectivity of a street,
- As the density increases, connectivity also increases.
- The disadvantage is the assignment using statistical data. It has deviations compare to the actual traffic flow, thereby affecting the route selection.

CAR (The Connectivity Aware Routing):

- Advantage of CAR (Connectivity Aware Routing) is that the connected path between source node and destination node could be found when the source node is positioning the location of destination node.
- This connected path has adaptability, when link breakage appears, it needn't to research process.
- But the routing overhead is still high.

CLWPR (Cross Layer Weighted Position based Routing):

- Follows minimal weight hop based routing periodically broadcasted by each node.
- The messages contain positioning information such as position, velocity and heading and other necessary information.
- This protocol calculates the distance to be travelled to reach the destination. To make this possible, e-maps are to be imported on the vehicles.

RBVT (Road based using vehicular traffic information):

- Uses real time traffic information to create path either proactively or on demand.
- In RBVT-R, paths are created on demand using connected segments which are paths between adjacent inter segments thereby ensuring network connectivity.

GeoSVR (Geographic Stateless VANET Routing protocol):

- Routes data using node location and digital map. This protocol consists of two main algorithms namely, optimal forwarding path algorithm and restricted forwarding algorithm.
- The main issue in forwarding data is the local maximum and sparse connectivity problem.
- Optimal forwarding path algorithm eliminates the problem of sparse connectivity by considering the vehicle density.

b. Paper 2 :- A Hybrid Architecture of Routing Protocols for VANET with Cross-Layer Design

Authors- Hung-Chin Jang, Chang-Kwei Yang

Conference/Journal - 2012 International Symposium on Computer, Consumer and Control,2012 IEEE

Summary:-

In this paper, they propose hybrid design with cross-layer style to produce different routing protocols per completely different desires. The hybrid design relies on multiple routing-path plane, cross-layer path choice, integration of broadcast packets, and a routing module integration layer (RMIL). Hybrid design based mostly

predicated on desegregation routing protocol of position-based and tropology based protocol.

Advantages:-

- Simulation results show that the planned resolution outperforms each AODV and GPSR in terms of delivery quantitative relation and turnout in each superhighway and grid-street situations.
- When road setting isn't favorable to any single routing protocol hybrid design improve the performance.

c. Paper 3 :- Network Coding: An Instant Primer

Authors - Christina Fragouli,/Jean-Yves Le Boudec /J¨org Widmer

Journal-LCA-REPORT-2005-010∗ ,infoscience.epfl.ch

Summary:-

This paper is an immediate primer on network cryptography: It explains what network coding will and the way it will it. They discuss the implications of theoretical results on network cryptography for realistic settings and show however network cryptography is employed in observe. It explain how we can encode and decode message, how we can combine two or more packages by using linear linear combinations of previously received information.

Advantages:

- By permitting to raised unfold data content within the network setting, it will change distributed algorithms
- Ad-hoc networks, overlay infrastructures and device networks are commencing to good thing about network secret writing. Additional such applications are expected to emerge.

d. Paper 4 :- DONC: Delay-based Opportunistic Network Coding Protocol

Authors - Farhan H. Mirani, Anthony Busson, Cedric Adjih

Conference/Journal - 2013 12th Annual Mediterranean Ad Hoc Networking Workshop (MEDHOC- NET), 2013 IEEE.

Summary:–

In this paper, they propose a Delay-based Opportunistic Network Coding protocol called 'DONC', which combines delay based techniques with opportunistic network coding, In order to successfully cancel effect of packet losses: DONC improves dissemination of broadcast data in VANETs and reduces packet retransmissions. They simulate DONC protocol in ns2 and compare it with classical delay-based VANET broadcast mechanisms. Results prove that DONC protocol outperforms other delay-based mechanisms, especially in the scenario of lossy VANETs. In addition its performance remains steady in less lossy scenarios.

V. CONCLUSION

In this paper, we have study the various routing protocols to improve efficiency of VANET and how network coding is useful in VANET for many different purpose. Right now whatever work is done, does not support robust reliability means messages are lost due to frequently dis-connectivity. So with the help of random linear network coding, we will incorporate above mechanism to improve reliability of VANET routing protocol.

VI. ACKNOWLEDGMENT

I would like to thank the Dr. Namrata Tapaswi and Dr. Archana Keerti Chowdhary for their insightful comments and encouragement, but also for the hard question which incented me to widen my research from various perspectives.
My sincere thanks also goes to my family members for their continuous encouragement through my college life. Without they precious support it would not be possible to conduct this research.

REFERENCES

[1] Christina Fragouli, Jean-Yves Le Boudec, J¨org Widmer, "Network Coding: An Instant Primer", LCA-REPORT-2005-010
[2] Farhan H. Mirani, Anthony Busson, Cedric Adjih, "DONC: Delay-based Opportunistic Network Coding Protocol", 2013 12th Annual Mediterranean Ad Hoc Networking Workshop (MED-HOC-NET), 2013 IEEE
[3] Ohara Kerusauskas Rayel, Jo˜ao Luiz Rebelatto, Richard Demo Souza," Network Coding for Cooperative MIMO Vehicular Ad-Hoc Networks", 2013 IEEE.
[4] Journal of Network and Computer Applications, Saif Al-Sultan n, Moath M. Al-Doori, Ali H. Al-Bayatti, Hussien Zedan Software Technology Research Laboratory, De Montfort University, Bede Island Building, Western Boulevard, Leicester LE2 7EW, UK (2013).
[5] Implementing a New Manet Unicast Routing Protocol in NS2 BY Francisco J. Ros Pedro M. Ruiz Dept. of

Information and Communications Engineering University of Murcia December, 2004

[6] Huijing Shi, Chong Ma, Liang Chen and Zhizhong Ding," IDVR-PFM: A Connectivity-oriented VANET Routing Protocol in Urban Scenarios", 2013 Fourth International Conference on Intelligent Control and Information Processing (ICICIP), 2013 IEEE

[7] YunGe, Xin Fan, Xing Wang, "A Stable Routing Protocol Using Segment-by-Segment Way in VANET", 2012 International Conference on Computer Science and Information Processing (CSIP), 2012 IEEE

[8] R. S.Y.R.Li and N.Cai. Linear network coding. IEEE/ACM Transactions on Networking, 11(5), October 2003.

[9] Network Simulator, http://www.isi.edu/nsnam/ns

[10] S. D. et al. Network coding for wireless applications: A brief tutorial. In Proceedings of International Workshop on Wireless Ad-hoc Networks (IWWAN), May 2005.

[11] C. Gkantsidis and P. Rodriguez. Network coding for large scale content distribution. In Proceedings of IEEE INFOCOM, 2005.

[12] J. Widmer and J.-Y. L. Boudec. Network coding for efficient communication in extreme networks. In ACM SIGCOMM'05, (Philadelphia, PA, USA), August 22-26 2005.

[13] S. R. Ahlswede, N. Cai and R. Yeung. Network information flow. In IEEE-IT, Vol. 46, pages 1204–1216, 2000.

[14] M. L. J. W. Byers and M. Mitzenmacher. Accessing multiple mirror sites in parallel: Using tornado codes to speed up downloads. In Proceedings of IEEE INFOCOM, April 1999.

[15] Ohara Kerusauskas Rayel, Jo˜ao Luiz Rebelatto, Richard Demo Souza," Network coding for Cooperative MIMO Vehicular Ad-Hoc Networks", 2013 IEEE