

SURVEY ON OPPORTUNISTIC ROUTING ALGORITHM FOR VEHICULAR ADHOC NETWORK (VANET)

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Abstract: Vehicle Adhoc Network (VANET) permits self organized infrastructure. Link or Connectivity breakage or long delay (intermittent connection) is an important issue in the VANET which arises due to the dynamic topological changes. Mainly two algorithms Vehicle assisted Data Delivery (VADD) and Opportunistic routing algorithm supports for handling delay/disruption tolerant network (DTN). Aim of the DTN is to create the dynamic link between the source and destination vehicle in the case of link disruption or absence of path between two nodes and forwards the data using store carry and forward. VADD carry and forward the data as much as possible in disconnected network using intersection mode, straightway mode or destination mode. Opportunistic routing can deal the unreliable data and intermittent connectivity in VANET by considering the multiple nodes as a next hop forwarder instead of considering pre-selected single node to be the best forwarder. This paper gives the study about various opportunistic routing algorithms for handling delay/disruption tolerant network.

Keywords: Vehicular Adhoc Network, Delay/Disruption Tolerant Network, Routing Protocols.

1. Introduction

The development of ITS (Intelligent Transportation System), to improve road safety and disseminate the emergency information in network, automobile industry triggered the researchers in the field of VANET. Two types of communication Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I) are supported by VANET using the IEEE standard 802.11p. VANET is the sub-class of MANET here the nodes are mobile vehicles. There is a high possibility for the vehicles to mobile anywhere because of its natural characteristics. Because of high mobility there is a high chance for frequent link disconnection and it cannot provide reliable data transfer [1]. Due to the sparse connectivity, intermittent connectivity, high mobility and latency, long delay, high error rates data communication get interrupted between the vehicles, that can be handled and communication takes place

between the vehicles by using the delay/disruption tolerant network (DTN). In this networks vehicles carries the data until it identifies the appropriate node to deliver or forward the data via the node. This is called as store-carry and forward mechanism. Vehicle DTN supports for many applications like emergency information broadcasting, advertisements, displaying the vehicle parking slot availability etc. Opportunistic routing and VADD are the two routing algorithms used in VANET DTN. A node carries the data until it meets the trusted intermediate node or the destination node in its coverage range. Due to the unpredictable nature of VANET using the pre-computed paths will lose the data while forwarding so the dynamic path selection at junctions will provide the optimal solution for reliable communication. VADD selects the path will low packet delivery in two situations. When nodes routing the message are located in the middle of a road and when they are located in a junction. Opportunistic routing is trajectory based protocol uses both the vehicle movement and the geographical information provided by Global Positioning System (GPS). In Opportunistic routing nodes stores the data until it receives a suitable node. For choosing the suitable next hop each node computes the closest point in their trajectory in direction of the destination [2].

2. Routing Issues and Challenges in VANET

There are various types of routing protocols are used in VANET. Broadcast based routing, Cluster based routing, Geocast routing, Position based routing, Topology based routing and hybrid routing. Each and every routing methodology is having some challenges during the implementation. In this survey position based routing is considered and one important issue is acknowledged, disruption or delay is considered as an important issue and handling this situation is a big challenge for researchers. Opportunistic routing algorithm provides the solution for this issue by implementing this algorithm in Delay/Disruption Tolerant Network.

2.1 A location aided controlled spraying routing (LACS)

In this paper, a Location Aided Controlled Spraying (LACS) routing algorithm is proposed to deal with the challenging issues in DTN routing. In LACS there is no need of global knowledge about the network and only the contacted nodes carrying the routing information alone need this algorithm. The routing process is divided into two stages, (i) controlled spraying routing stage and (ii) single-copy routing stage. In controlled spraying routing stage the current node use the spraying technique depends on the angle of contact node. In the single-copy routing current node predicts the destination node location using Semi Markov process and then decides whether to forward the message to the target node. Random Way Point (RWP) model is used for simulation. Comparing to the traditional model LACS produced higher delivery ratio and less transmission when the buffer space increased, the transmission delay increased if buffer space is less than 20MB [3].

2.2 An Opportunistic Routing for Data Forwarding Based on Vehicle Mobility Association (OVMA)

Identifying the appropriate data forwarding path for data transmission with low delay is an important role in VANET. In this paper vehicle mobility association based routing protocol for data forwarding in VANET is proposed. Forwarding to the extra intermediate nodes can be reduced with this routing protocol. The Manhattan Mobility model is used for the vehicle movement. The data transmission probability is built into the Hidden Markov Model (HMM) decision. By using this model the probability of forwarding movement is set to 0.5 and the probability of left turn and right turn is 0.25 respectively. Each vehicle carries the information about the associated vehicle, so that the routing decision can be done based on the vehicle density. The OVMA protocol can increase the network lifetime, improve the performance of data delivery ratio, and reduce the data delay and routing overhead when compared to the other well-known routing protocols. The simulation result shows that the routing overhead increases gradually when the number of vehicle increases because the routing frequency is high. Finally the path discovery is considerably slow because of increasing the number of nodes participating in the network [4].

2.3 Joint Link State and Forwarding Quality: A Novel Geographic Opportunistic Routing in VANETs (LF-GOR)

Important challenges of routing protocols in VANET is it suffers from frequent link disconnection and delay in packet delivery. To address this issue, Geographic

Opportunistic Routing protocol is introduced based on link state and Forwarding quality inside nodes (LF-GOR). For determining the candidate nodes set of the sending node in LF-GOR, one hybrid approach is used namely filtering and prioritizing which considers the position information, link state and node's forwarding quality. In the existing, link state only considers the transmission time q but in this paper addition to the transmission time q it considers the retransmission limit ζ also for considering the link state it is notable one. Forwarding quality inside a node is done by introducing the new layer DaMo (Data Monitor) between the MAC layer and Network Layer of OSI model. This layer is used to monitor the incoming and outgoing packet traffic through DaMo. 200 nodes are taken for the simulation when 140 nodes are used it is having the peak packet delivery rate. This delivery rate is not increased gradually when the nodes are increased. It uses the influence of link state to improve the network throughput it worked really well but throughput is not gradually increasing when the no of nodes are increased. On the whole this algorithm is having acceptable end to end delay [5].

2.4 Location and Direction Aware Opportunistic Routing in Vehicular Ad hoc Networks (LDAOR)

Routing in VANET is considered as an important issue because of its exceptional feature such as lack of energy constraints and frequent link breakage. Designing routing algorithm for highly dynamic network is the challenging task, so the appropriate opportunistic routing called Location and Direction Aware Opportunistic Routing (LADOR) is introduced in this paper where the transmission is performed using store-carry and forward mechanism. LADOR has two phases i) neighbor node selection phase ii) determining the priority of message for transmission. Neighbor node is selected by using vehicles positions, vehicles directions, and prioritization of messages from buffers, based on contact histories and positions of neighbor nodes to destination. When multiple nodes approaches the carrier node, the neighbor node is selected, which is closer to the destination. The end to end delay is high when the no of nodes are small because of the parameters used by the LDAOR, but the overhead is less in all situations that can be appreciated. Additionally traffic flows from buffers are considered in this paper which will supports for improving the delivery ratio. A message in a buffer only sent to the neighbor node which is very closer to the destination node, because of this additional transmission and receiving of messages are reduced, so that the bandwidth can be efficiently used. LADOR not only increasing the delivery rate, it also avoids flooding and traffic flows [6].

2.5 An opportunistic routing based on symmetrical traffic distribution in vehicular networks (OSTD)

Finest route selection is the important performance metrics for efficient data delivery with low end to end in VANET. In this paper opportunistic routing algorithm is introduced based on the symmetrical traffic distribution (OSTD). This algorithm firmly considers the vehicular distribution for the calculation of utility function which is used to evaluate the network route. Considering the vehicular distribution for route selection is very important than other factors such as vehicle density and Euclidean distance. This OSTD algorithm is designed as two phase algorithm i) intersection selection phase and ii) Next hop selection phase. Queue management method is used for improving the data delivery ratio. The result shows that the data delivery ratio is gradually reducing when the data sending rate is increased. Data delivery ratio is increased when the numbers of nodes are increased gradually. Due to the weak wireless link the fraction of packet loss is increased when the packet sending rate is increased. In OSTD end to end delay is very less, even in the increased number of nodes and data sending rate [7].

2.6 A Trusted Routing Protocol Based on GeoDTN+Nav in VANET (GeoDTN+NAV)

Trust management between nodes becomes more difficult in the VANET because of the characteristics of high mobility. In this paper this problem is solved by introducing the new trusted routing protocol based on GeoDTN+Nav by using Bayesian trust management model. This GeoDTN+NAV is outfitted with Virtual Navigation Interface (VNI), which is used to find the nearby vehicles and provides navigation interaction information with consistent format. VNI contains two elements (Nav-info, confidence). Nav_info provides the detailed route to the destination and vehicle movement direction. Confidence provides the probability to reach destination node. This protocol consists of four phases i) initialization Phase, ii) Route discovery, iii) Route establishment and iv) Route deletion. In simulation results shows that correct ratio of received packets is high and number of packets forwarded by this routing protocol is also considerably high [8].

2.7 LSGO: Link State aware Geographic Opportunistic routing protocol for VANET (LSGO)

Due to the unstable link connectivity and high topological changes robustness and efficient data delivery is the issue in VANET. With the help of broadcasting characteristic and additional backup links the opportunistic routing can improve the reliability of routing. In this paper such routing algorithm is introduced based on the state of the link and location

called link state aware geographic opportunistic routing (LSGO). This protocol improves the reliability of the data by selecting the forwarders and prioritizing them based on the vehicle location and link quality. This protocol contains three parts i) link quality estimation, ii) candidate node set selection done by link transmission rate and iii) priority scheduling algorithm based on the time. In the simulation the results shows that packet delivery ratio is high, packet dropping rate is low, end to end delay is acceptable and routing overhead is increased with the increase in vehicle speed and number of vehicles [9].

2.8 Connectivity-aware minimum-delay geographic routing (CMGR)

For the routing issue raised in VANET due to the continuous topological changes, Connectivity-aware Minimum-delay Geographic Routing (CMGR) is introduced in this paper. CMGR supports efficiently for both the sparse and dense network. For extending the chance of packet reception in sparse network CMGR considers the connectivity of routes in its route selection. In dense network CMGR determine ample connectivity between nodes and selects the route among them with minimum delay. IPv6 is considered as network protocol and anycast addressing is used in this paper. For selecting the most appropriate route a naïve approach is used to select the route with is maximum value of the minimum vehicle density. In this paper two limitations and its solution are addressed i) Vehicle tracking mechanism for the moving destinations and ii) packet forwarding decision at sparse junctions. Vehicle tracking mechanism increases the control overhead because of generating beaconing messages at the junction. The simulation result shows that packet delivery ratio is increased but not gradually increased when the numbers of vehicles are increased. Delivery delay is high in sparse network and it is gradually getting decreased in dense network. Drawback of this mechanism is dropped data packet ratio is increased when the vehicle count is increasing [10].

2.9 Road traffic and geography topology based opportunistic routing for VANETs (ORRIS)

In this paper opportunistic routing is proposed based on the geographic location and road traffic flow analysis for handling the issue transmission delay and packet delivery ratio. Generally data transmission takes place between two vehicles using dedicated short range communication. For making communication between two vehicles this ORRIS algorithm use the Road Side Unit (RSU), since the topology of the network is restricted to the spatial distribution of road and store carry and forward mechanism is used in VANET. This algorithm is generated for straight road communication

which uses greedy forwarding and intersection road communication which considers the angle between two nodes as important parameter. Simulation ratio shows the packet delivery success ratio is high when the numbers of vehicles are increased, transmission delay is decline and steady and dropped packet ratio is also considerably low [11].

2.10 Multi-Metric Opportunistic Routing for VANETs in Urban Scenario (MMOR)

Multi-hop routing is a prominent issue in VANET, based on that this paper introduces an opportunistic algorithm called Multi-Metric Opportunistic Routing (MMOR). This algorithm identifies the best opportunistic next forwarding node for transmitting the data from source to destination. MMOR contains three portions i) Neighbor node's information collection ii) Forwarding candidate set selection and iii) Opportunistic forwarding. Nearby node information can be collected with the help of node equipped with device position and electronic map. In forwarding candidate set selection it considers the distance between candidate node and destination node, Candidate node packet process load, candidate node moving direction and velocity and neighbor node density. Since MMOR takes multi metrics into consideration for best routing the packet drop ratio is low, simulation results shows throughput is low and end to end delay is high when the numbers of nodes are increasing gradually. In the conclusion self-adaptive routing according to the dynamic traffic network is considered as future work [12].

Comparative Analysis:

The following table shows the analysis of various Opportunistic routing algorithm contribution in VANET for attaining various parameters.

Opportunistic Routing Algorithms	Delivery Ratio	Network Overhead	Transmission Delay	Reliability	Throughput	Traffic loss	Packet loss	Security
LACS	high	high	High					
OVMA	Improved	High when no of nodes are less	Reduced					
LF-GOR	High		Acceptable	high	high			
LDAOR	Increases	reduces				Reduced		
OSTD	High		Low				Low	
GeoDTN+NAV	High		Low					High
LSGO		increases	Reduced	increased			reduced	
CMGR	High						reduced	
ORRIS	High	low	low					

2.11 A Localized Efficient Forwarding Algorithm in Large-scale Delay Tolerant Networks [LOOF]

In VANET effective forwarding can be done by using global or local information in delay tolerant environment. In this paper by considering the local information alone an opportunistic algorithm is created called Local Optimistic Opportunistic Forwarding [LOOF]. By using the available local information this algorithm works optimistically and the simulation results shows that packet delivery rate is high and delay is very low [13].

2.12 Specific Opportunistic Routing at Road Intersection in VANETs (SOR)

Self-Organized network can be generated without the support of any permanent infrastructure in VANET and routing is a challenging issue in due to the high mobility, dynamic topology and high density of vehicles. In this paper position based routing algorithm is proposed for road intersection. Advantage of the position based algorithm is forwarding is done with the awareness of destination node location, own position and the position of one-hop neighbor so that forwarding becomes easy. This kind of algorithm will not support for rural area because of terrain effects and GPS cannot extend its service in the tunnel because of the absence of signal in such environment. This algorithm is executed based on the shortest path and best junction selection. Drawback of this algorithm is performance is getting reduced in high mobility, when the number of nodes increased data delivery delay is increased and packet delivery delay is decreased [14].

MMOR	High		low					
LOOF	High		Low					
SOR	High When no of nodes are less	Low When no of nodes are less						

3. Conclusion

Routing in VANET is a challenging task because of its intermittent connectivity and high mobility. This characteristics result in degrading the routing performance of using traditional routing protocols. In order to handle the delay/disruption two new routing algorithms VADD and Opportunistic are suggested for delay/disruption tolerant network. In this paper various Opportunistic routing algorithms are discussed and its various parameters like Delivery ratio, Network Overhead, Transmission delay, Reliability, Throughput, traffic and packet loss and security were analyzed.

References

- [1] Elias C. Eze, Sijing Zhang and Enjie Liu, "Vehicular Ad Hoc Networks (VANETs): Current State, Challenges, Potentials and Way Forward", 20th International Conference on Automation & Computing, 12-13 September 2014.
- [2] Ramin Karimi, Norafida Ithnin ,Shukor Abd Razak and Sara Najafzadeh," DTN Routing Protocols for VANETs: Issues and Approaches", IJCSI International Journal of Computer Science Issues, Vol. 8, Issue 6, No 1, November 2011.
- [3] Hang Guo, Xingwei Wang , Hui Cheng , Min Huang,"A location aided controlled spraying routing algorithm for Delay Tolerant Networks", Elsevier, August 2017.
- [4] Leilei Wang, Zhigang Chen and Jia Wu," An Opportunistic Routing for Data Forwarding Based on Vehicle Mobility Association in Vehicular Ad Hoc Networks", information, Nov 2017.
- [5] Weiwei Dong, Changle Li and Zhifang Miao," Joint Link State and Forwarding Quality: A Novel Geographic Opportunistic Routing in VANETs",IEEE, 2016.
- [6] Marziyeh Barootkar, Akbar Ghaffarpour Rahbar, and Masoud Sabaei, "LDAOR Location and Direction Aware Opportunistic Routing in Vehicular Ad hoc Networks", Journal of Telecommunications And Information Technology, Jan 2016.
- [7] Nassim Mirjazaee and Neda Moghim," An opportunistic routing based on symmetrical traffic distribution in vehicular networks", Journal of Computers and Electrical Engineering, Aug 2015.
- [8] WU Qiwu, LIU Qingzi1, ZHANG Long, ZHANG Zhiming," A Trusted Routing Protocol Based on GeoDTN+Nav in VANET", BIG DATA, CLOUD & MOBILE COMPUTING, 2014.
- [9] Xuelian Cai, Ying He, Chunchun Zhao, Lina Zhu and Changle Li," LSGO: Link State aware Geographic Opportunistic routing protocol for VANETs", Cai et al. EURASIP Journal on Wireless Communications and Networking ,2014.
- [10] Kaveh Shafiee, and Victor C.M. Leung," Connectivity-aware minimum-delay geographic routing with vehicle tracking in VANETs", Ad Hoc Networks ,2011.
- [11] DING Yu, LIU Ya-zhi, GONG Xiang-yang and WANG Wen-dong," Road traffic and geography topology based opportunistic routing for VANETs", The Journal of China Universities of Posts and Telecommunications, Aug 2014.
- [12] Qi Chen, Nan Cheng, Xinhong Wang and Fuqiang Liu," Multi-Metric Opportunistic Routing for VANETs in Urban Scenario", International Conference on Cyber-Enabled Distributed Computing and Knowledge Discovery, 2011.
- [13] Yuxing He, Cong Liu, Yan Pan, Jun Zhang, Jie Wu, Yaxiong Zhao, Shuhui Yang, and Mingming Lu," A Localized Efficient Forwarding Algorithm in Large-scale Delay Tolerant Networks", IEEE 11th International Conference on Mobile Ad Hoc and Sensor Systems,2014.

