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Comparison Study on Non-Delay Tolerant Routing Protocols in Vehicular Networks

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Abstract

Vehicular Ad-hoc network is an emerging technique for the Ad-hoc networks and Intelligent Transport System (ITS).VANET is mainly used for avoiding the accident and shares the traffic information among the vehicles. For sharing the information among the vehicles many challenges are faced, because the VANET has dynamic topology and high mobility model. To resolve this problem, VANET has many types of the routing methods and various routing protocols, but those routing protocols do not fully resolve the problem during the communication. In this paper we discussed, Position based routing method andNon-delay tolerant routing protocols, its advantages and issues.

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*Keywords:*VANET,Routing,Position based routing,Non-Delay tolerent protocols

1. Introduction

Vehicular Ad-hoc Networks are an advanced technology for integrating the vehicles as a network topology. Vehicular communication has the large number of applications such as Intelligent Transport System (ITS) [1], safety application and payment services. The work of ITS is to measure the traffic information and to send that information to other vehicles for maintaining the traffic system. Safety applications cooperate the safe driving to the driver. This application has to inform the collision warning and lane change notification to users. Payment services offer the direct payment for parking charges and toll gate cost.

VANET provides communication between vehicles in three ways. They are, Vehicle-to-Vehicle (V2V), Vehicle-to-Infrastructure (V2I) and hybrid. Hybrid communication is a combination of V2V and V2I

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communication. Dedicated Short Range Communication (DSRC) [2] is a device used for communicating vehicles in VANET. DSRC is to keep up a communication range up to 1000m and frequency ranges from 5.85 to 5.925GHz. Other than DSRC, VANET has been using some communication devices such as WAVE (Wireless Access for Vehicular Environment) [3] and Wi-Fi.

VANET is a subclass of Mobile Ad-hoc Networks (MANET), because in VANET some of the operations like self-organization, low-bandwidth, self-management and radio transmission conditions are similar to MANET. For this reason, MANET protocols[4] are adopted to VANET environment. VANET has high mobility and dynamic topology pattern. For these characteristics, the routing path is frequently broken. So, MANET protocols do not give the efficient performance of routing.

In this paper, we are focusing position based routing method and discuss the non-delay tolerant routing protocol strategies, strengths and limitations. The remainder of the survey paper is presented as follows, position based routing methods in VANET is discussed in section II; Section III presents the Non-delay tolerant routing protocols and their pros and cons, Section IV presents the comparison table for non-delay tolerant routing protocol. At the last, Section concludes this survey paper.

2. Position based routing

Position based routing is also known as a geographical routing. The routing path is constructed based on the location. It monitors the location information of the vehicles using Global Positioning System(GPS).This method does not maintain routing table, instead it uses the location information of Source node, next-hop node and destination node to perform routing. The routing is carried out through the following procedures,

2.1Path selection

The routing path is constructed based on the Djikstra algorithm. It computes the shortest path between the source node and the destination node. In VANET the routing path is not stable, so that the path selection is not guaranteed. To resolve this problem, the path is constructed based on the destination and position of the next node or junction.

2.2 Link Estimation Time (LET)

To improve the performance of the routing path, the LET [8] is calculated. It measures the link availability in a network. Using LET, the frequent link failure in routing is eliminated. LET calculation is based on the position,direction and velocity of the vehicle. GPSR-L [9], MOPR [10] and CLWPR [11] protocols are the protocols which use LET method in position based routing.

2.3 Forwarding

After selecting the path or next junction, the packet delivery is dependent on greedy forwarding. Greedy forwarding strategies are as follows; commonly greedy forwarding sends the packet when the source node is closer to destination. Improved greedy forwarding sends the packets based on the direction and velocity of vehicles. Directional greedy forwarding sends a packet to the destination directly. Restricted greedy forwarding is performed when the vehicles are stationary, in routing path.

2.4Recovery

When the source node does not contain the next hop node during greedy forwarding in local maximum or local optimum. Aforementioned problem the link is not established to destination, so the packets are forwarded to destination using right-hand rule and carry-and-forward methods.

Position based protocols are classified into Non-delay tolerant network (Non-DTN), delay tolerant network (DTN) and hybrid protocols. Non-DTN protocols aims to transmit a packet from source to destination as soon as possible. This Non-DTN protocols are classified as beacon and beaconless protocols based on the type of messages it uses. DTN protocols derived for improving the performance during continuous disconnectivity of a network. DTN

transmits a packet depending on the metrics of a neighbor node. The transmission is processed using Carry-and-Forward method. In Hybrid position based protocol, the packet transmission is based on greedy forwarding and recovery modes.

3. Non-Delay Tolerant Routing Protocols

3.1 Greedy Perimeter Stateless Routing (GPSR)

GPSR [12] is a Non-DTN position based routing protocol. In this protocol the packet transmission is made-up on two modes of operation. First method is Greedy Forwarding, in this method the node directly transmits a packet to neighbour node which is closer to destination. Packet has the location information of neighbour node, destination and data. The location information of neighbour node is sent to the currently active node using beacon messages. In some cases, the source node does not contain the closer node to destination. In these scenario, greedy forwarding fails, so to recover this problem the Perimeter method is used. This method uses the right-hand-rule to transmit a packet. When the packet reaches the local maximum the right-hand rule is invoked. It directly sends a packet to destination. GPSR produces good results in highway environment compare to urban area. In Urban areas the direct communication is rare due to the presence of more buildings and trees.

3.2 Geographic Source Routing (GSR)

GSR [13] is to overcome the drawbacks of GPSR. It works by coordinating the Position based routing and topology based routing method. Communication between source node and destination node is done using a unicast method. The location information of destination is identified by Reactive Location Service (RLC). Digital map are used to identify all junctions from source node to destination. Using this information GSR computes the various paths from source to destination, Dijkstra algorithm finds out the shortest path of a routing process. Greedy forwarding is used to recover the routing process, when the neighbour node is not available to destination. GSR performs well in urban environment. Compare to Ad-hoc On demand Distance Vector (AODV) and GPSR, it gives the better performance. Drawback of this method is network overhead, since it frequently sends the location information of nodes. Other drawback is the path disconnectivity due to topology changes in VANET.

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

A-STAR [14] is a position based protocol to provide an effective communication for vehicle to vehicle network (V2V) in urban environment. It computes an anchor path for transmitting packets in Non-DTNetwork. The paths are constructed using traffic awareness. Traffic awareness is measured using statistically related maps and dynamically related maps. Statistically related maps are used to find out bus routes in urban area and dynamically related maps are used to measure the latest traffic information. Optimal path is selected using Dijkstra algorithm. A-STAR protocol is proposes a new technique for the recovery process, i.e. When a street reaches to the local maximum, it is temporally marked as Out-of-Service. In this stage the communication is not performed. So A-STAR constructs a new anchor path for communication. In A-STAR,the packet delivery ratio is 40% higher than GPSR and GSR. Drawback of this approach is end-to-end delay in average range.

3.4 GpsrJ+

GpsrJ+ [15] is a Non-DTN protocol in position based routing for V2V communication. It is to predict route junction in two hop neighbor beaconing. GpsrJ+ transmits packets to the neighbor node based on the location of a junction. It is mainly used for transmitting a packet, when the node located in more than one road segment. The packet transmission has following steps,

Step 1: Source node waits for beacon message from neighbor nodes, for choosing a next hop node.
Step 2: Neighbor nodes send beacon message to source node.
Step 2.1: If the Neighbor node is not present in more than one road segment then the packet is delivered directly.
elseif :neighbor node is located in more than one road segment.

Then: Source node sends a packet to furthest neighbor node.
Step 3: Neighbor node sends the packet to destination node.
GpsrJ+ gives the high packet delivery ratio and this protocol also makes use of traffic awareness in deciding the routing path.

3.5 Greedy Traffic Awareness Routing (GyTAR)

GyTAR [16] is a junction based routing protocol that is well performed in urban areas. Source node uses Grid Location Service (GLC) to find out the distance of a destination. Digital maps are used to find out the location of destination. GyTAR routing is fully based on choosing a junction in urban area. Vehicle density and curve-metric distance to the destinations are used in selecting junctions. Infrastructure-free Traffic Information System (IFTIS) is used to measures vehicle density between two junctions. The junction is selected based on the maximum junction scoreS_j.

$$S_j=\alpha*T_j+\beta*D_j$$

Where,
$\alpha$and β Weighted factors
T_j is a Traffic density
D_j is a curve-metric distance

After selecting the junction, GyTAR chooses the routing path using Dijkstra shortest path algorithm. Carry-and-forward method is too used when the connections are not established to destination. Compared to GSR, GyTAR gives better Packet Delivery Ratio (PDR).

3.6 Connectivity-Aware Routing (CAR)

Like other position based protocols, the connectivity Aware Routing protocol [17] is used to find the optimized route between the sources and destination. It also predicts the location information of vehicle, repairs routes as those positions change. In this protocol, the beacon messages containing the “Velocity vector” information of the nodes are sent to the other nodes. As soon as a node receives a beacon message, it will register the sender in its neighbor table and calculates its own velocity as well as neighbor node's velocity vector. CAR protocol uses “guard” to track the current location of destination. It contains ID, TTL (Time-to-Live) counter, a radius and some state information. CAR protocol provides two guard models: Standing guard and traveling guard. After discovering the route using these guards, an Advanced Greedy Forwarding (AGF) technique is used to send the packets. Two ways of recovery methods are provided by CAR, when it encounters a failure in the communication link or when the guards were not maintained due to low traffic density. The recovery methods are “Time out algorithm with active cycle” and “Walk around error recovery”. This protocol does not need location services and maps. It gives the good PDR and reduced wasted bandwidth.

3.7 Contention Based Forwarding (CBF)

We already discussed the beacon based protocols under position based routing. In that protocols the beacon messages are used to transfers the information to vehicles. Due to high mobility and rapid topology changes the information becomes invalid rapidly. CBF [18] protocol is a unicast and beaconless position based protocol which is used to overcome this problem. In CBF protocol the source node broadcasts packets to all neighbour nodes. It uses a biased timer based container process to determine the next hop node. In this way the routing is performed in CBF protocol. The greatest advantage of this protocol is it reduces the bandwidth and network overhead.

3.8 Cross Layer Weighted Position based Routing (CLWPR)

CLWPR [11] is a cross layer protocol, it uses a cross layer information to make more effective routing decisions. It also supports the carry-and-forward mechanism. This routing method establishes a next hop node based on the joint weighting function.

Weight= **f1**Distance + **f2**NormAngle+
f3NormRoad + **f4**Utilization+
f5MACinfo+**f6**CnFinfo+ **f7**SNIRinfo

The minimal weight node is established as the next-hop node. CLWPR computes a link estimation time. It is used to measure the link quality and reduce the week links during a communication process. Compared to other routing protocol in VANET, CLWPR performs well and produces a higher packet delivery ratio and less end-to-end delay.

4. Comparison

In this section we are discussed the various parameters with Non-delay tolerant routing protocols in Vehicular networks.

Table. 1. Non-Delay Tolerant protocols comparision

Parameter	GPSR	GSR	A-STAR	GpsrJ+	GyTAR	CAR	CBF	CLWPR
Communication	Unicast	Unicast	Unicast	Unicast	Unicast	Unicast	Unicast	Unicast
Forwarding method	Greedy	Greedy	Improved Greedy	Greedy	Improved Greedy	Greedy	Greedy	Greedy
Recovery method	Right hand rule	Greedy	Recalculate path	Greedy	Carry and forward	Greedy	Greedy	Carry and forward
Traffic awareness	No	No	Yes	No	Yes	Yes	No	Yes
Map required	No	No	Yes	No	Yes	Yes	No	Yes
Vehicle density	Low	High	Medium	High	Medium	Medium	High	High
Speed	Medium	Not Determine	Medium	Medium	Medium	Medium	Not Determine	High
Link Estimation time	No	No	No	No	No	No	No	Yes
PDR	Low	Medium	Medium	Medium	Low	Low	High	High
Latency	High	Medium	Not Determine	Medium	Low	High	High	Low
Environment	Highway	Urban	Urban	Urban	Urban	Urban	Urban	Urban
Simulator	NS2	NS2	NS2	QualNet	QualNet	NS2	NS2	NS3

5. Conclusion

In this paper, we present main category of routing method for position based routing and Non-Delay tolerant protocol in VANET, which may be promising technology for Intelligent Transport System (ITS). Designing of position based routing protocols has many challenges like high mobility vehicles, obstacles in routing path in VANET environments. VANET routing methods, merits and demerits of non-delay tolerant routing protocols are discussed.

References

1. www.itsindia.org
2. Jing Zhu , St. Louis, MO, USA ; Roy, S.," MAC for dedicated short range communications in intelligent transport system," IEEE Commun Magazine ,Dec 2003,Vol.41 , no.12,pp.60-67
3. Weidong Xiang, Richardson, P, JinhuaGuo,"Introduction and Preliminary Experimental Results of Wireless Access for Vehicular Environments (WAVE) Systems," in Proc. 3rd Annual International Conference on Mobile and Ubiquitous Systems - Workshops, 2006,pp. 1-8.
4. S. Corson, and J. Macker, "Mobile Ad Hoc Networking (MANET):Routing Protocol Performance Issues and Evaluation Considerations,"RFC editor, 1999.
5. Fan Li and Yu Wang, University of North Carolina at Charlotte"Routing in Vehicular Ad Hoc Networks: A Survey" IEEE Vehicular magazine,2007,pp-12-22
6. BaraaT.Sharef,Raed A. Alsaqour, Mahamod Ismail," Vehicular communication Ad-hoc routing protocols:Survey", Journal of Networks and Computer Applications,2014,Vol-40,pp363-396.
7. Sourav Kumar Bhoi, Pabitra Mohan Khilar,"Vehicular Communication Survey"IET Networks,2014, vol.3,pp.204-217
8. KarthikeyanL,SelvakumarS,BalasubramaniS"ELRT:Improved Packet Delivery Ratio using Enhanced Link Residual Time in VANET", Advanced in Natural and Applied Science,2014,pp-21-24
9. Rao S, Pai M, Boussedjra M, Mouzna J. "GPSR-l: Greedy perimeter stateless routing with lifetime for VANETs". In: Eighth international conference on ITS tele- communications, 2008. ITST; 2008. p. 299–304.
10. Menouar H, Lenardi M, Filali F." Movement prediction-based routing (mopr) concept for position-based routing in vehicular networks". In: IEEE 66th vehicular technology conference, 2007. VTC-2007 Fall; 2007. p. 2101–5.
11. Katsaros, Konstantinos, et al. "CLWPR—A novel cross-layer optimized position based routing protocol for VANETs." Vehicular Networking Conference (VNC), 2011 IEEE. IEEE, 2011.
12. Karp B ,Kung HT."GPSR: greedy perimeter stateless routing for wireless networks". In: Proceedings of the 6th annual international conference on mobile computing and networking;2000.p.243–54.
13. Lochert C, Hartenstein H, Tian J, FusslerH Hermann, D ,Mauve M. "A routing strategy for vehicular adhoc networks in city environments". In: Proceedings of the IEEE intelligent vehicles symposium;2003.pp.156–61.
14. Seet C, Liu G, Lee B S, Foh C H, Wong K J .Lee K K A-STAR: a mobile adhoc routing strategy for metropolis vehicular communications Networking technologies, services, and protocols; performance of computer and communication networks; mobile and wireless communications. NETWORKING, 2004, pp.989–99.
15. Lee SJ,SuW,GerlaM."On-demand multicast routing protocol in multihop wireless mobile networks". Mobile Networks and Applications2002;7:441–53.
16. JerbiaM,Senouci SM, Meraihi R, Ghamri-DoudaneY. "An improved vehicular adhoc routing protocol for city environments". In Proceedings of the IEEE international conference on communications,ICC'07;2007.p.3972–9.
17. NaumovV, GrossTR. "Connectivity-aware routing(CAR) in vehicular ad-hoc net works" In: Proceedings of the 26th IEEE international conference on computer communications, INFOCOM'07;2007.p.1919–27.
18. Füßler H, Hartenstein H, Widmer J, Mauve M, Effels berg W. "Contention-based forwarding for street scenarios" .In: Proceedings of the 1st international workshop in intelligent transportation (WIT'04), 2004.p.155–9.