Available Online at www.ijcsmc.com

International Journal of Computer Science and Mobile Computing

A Monthly Journal of Computer Science and Information Technology

ISSN 2320–088X

IJCSMC, Vol. 5, Issue. 2, February 2016, pg.206 – 212

Position Based Routing Protocols for Vehicular Ad Hoc Network: A Review

Ajay Kumar Singh[1], Ram Shringar Rao[2], Anurag Singh Baghel[3]

[1,3] School of Information & Communication Technology , GBU Greater Noida U.P, India

[2]Department of Computer Science & Engineering, Ambedkar Institute of Advanced Communication Technologies & Research, India

265957ajay@gmail.com [1]; rsrao08@yahoo.com [2]; asb@gbu.ac.in [3]

Abstract— Today's era is the era of Automobiles. The numbers of vehicles on the road are increasing rapidly. Drivers have a very little time to react while driving vehicle on a very high speed. So they need to be aware about the traffic conditions, accidents, road jams and other such emergencies. So Vehicular Ad Hoc Network can be used as a tool to improve the road safety by circulates the information. Vehicular Ad hoc network is a field of technology which allows vehicles to communicate to each other VANET is a form of Mobile Ad hoc network in which vehicles are equipped with wireless communication devices. This allows vehicles to vehicle to vehicle (V2V) and vehicle to road side unit (V2I) communication. To provide a reliable and efficient VANET routing protocol using fuzzy logic is still an open research topic. So here we are going to study about the various routing protocols which can be provide efficient routing by using fuzzy logic.

Keywords— vehicular ad hoc network, routing protocols, position based routing, fuzzy logic.

I. Introduction

As the vehicles are increasing rapidly day to day, the possibility of accidents has also increased. According to the National Highway Traffic Safety Administration (NHTSA), there are around 43000 deaths /year, 2.7 million people injured/ year and $230 billion social cost. It is required to make our vehicles a bit intelligent so that we can reduce the possibilities of accidents [1]. To avoid this type of accidents we have to use Vehicular Ad hoc Network (VANET). A vehicular ad-hoc network (VANET) is a specialized network that has unique characteristics which makes it different from other wireless networks.

Wireless Vehicular Ad Hoc Network (VANET) is an innovative wireless network that is rapidly developing accompanied by the advancement of wireless and automotive technologies. VANETs are automatically produced between moving vehicles having either same or different wireless interfaces. VANETs are a good example of a real-life application of the ad-hoc network that provides communication between the vehicles and other road side units and other infrastructures on the road. It has a variety of usages from private entity cars to the public transportation such as buses and other conveys vehicles. One of the most practical applications of Ad-hoc networking technology is certainly the Vehicular Ad-hoc Network (VANETs).

VANETs are not only restricted for commercial uses and entertainment applications but also expanded for the safety and traffic management. In these areas, Quality of Service (QoS) is the most important virtue. Safety information must be carried well-protected in networks that are self-managing with limited degrees of freedom in node movements and high speed variations. These circumstances will cause a network topology to experience quick and constant changes. Various researches with results derived from simulations have been done related to routing, communication robustness, and information dissemination to take these points into usable applications such as very simple radio propagation models available in simulation tools [2]. Vehicular communications in

VANET1 has been broadly classified into two types, namely, Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communications as shown in Figure 1.

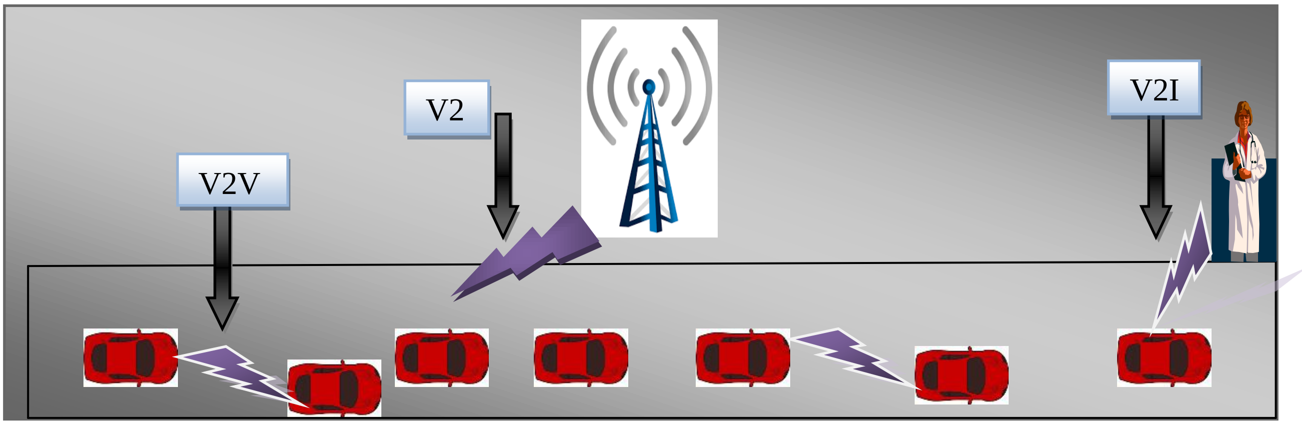

Figure 1. Vehicular Ad hoc network Architecture

In both (V2V and V2I) methods vehicles can communicate to other vehicles or road side unit either directly or through multiple hops. The communication depends on the positions of the vehicles. Further, the road side units (RSU) can also communicate with other road side unit via single or multi hop fashion. The RSU supports a lot of applications like message delivery, road safety, maintain connectivity by sending, receiving or forwarding data in the network. The main objective of VANET is to provide real-time and safety applications for drivers and passengers. By delivering message on time can decrease number of accidents and save journey time. The RSU can improve traffic management system by providing information to drivers and passengers i.e., collision warnings, blind turn warning, road sign alarms, etc. There are several services currently support by VANET are internet connections facility, electronic toll collection, and a variety of multimedia services. It is desirable that protocols should maintain the low end-to-end delay and, low overheads, high delivery ratio, and minimum numbers of hops.

There are several types of routing protocols for VANETs like topology based, broadcasting based, cluster based, position based etc. These routing protocols have aspects during route establishment which decide and effect the routing decision. But there is a need to develop an efficient routing protocol for VANET still that can provide good results with dynamic nature of the network and important information. Since each vehicle in VANETs is GPS enabled it helps to keep the track of its neighbor nodes, therefore position-based routing is the most suitable routing protocol for highly dynamic type of networks such as VANET. As in VANET source and destination nodes may be at great distance from each other, therefore selection of next forwarding node by packet carrier node is an essential activity in multi-hop routing [3].

II. CHARACTERISTICS OF VANET

Highly Dynamic Topology:-

The speed and selection of path defines the dynamic topology of VANET. In the VANET scenario the vehicle drivers have a very less time to react. If we assume two vehicles moving away from each other with a speed of 60 mph (25m/sec) and if the transmission range is about 200m, then the link between these two vehicles will last for only 4 seconds (200m/ 50ms-1). This defines its highly dynamic topology.

Frequently Disconnected Network:-

As the vehicles are move at a very high speed the frequent disconnection of links between then takes place. The above feature necessitates that in about every 4 seconds or so, the nodes needed another link with nearby vehicle to maintain seamless connectivity. But in case of are at times addressed by road-side deployment of relay nodes.

Communication Environment:-

The mobility model highly varies on highways in comparison to city environment. Therefore the node prediction design and routing algorithm also need to adapt these changes. Highway mobility model, which is essentially a one-dimensional model, is very simple and easy to predict. But for city mobility model, street structure, variable node density, presence of trees and buildings that behave as obstacles to even small distance communication make the model application that very complex and difficult.

Hard Delay Constraints:-

The safety aspects of VANET application (such as accidents, brake event) warrants on time delivery of message to relevant nodes. It cannot compromise with any hard data delay in this regard. Therefore high data rates are not important as an issue for VANET as overcoming the issue of hard delay constraints.

III. CHALLENGES IN VANET

VANET is defined under some challenges and provides some configurable properties along with associated challenges. Some of these challenges associated to mobile network are shown in figure 2. These challenges include the communication adaptive as well as architecture constraints based limitations of the network. The foremost challenge in vehicular network is dynamic communication and topology transformation. The network is established in wide area with mobile vehicular nodes. The position of these vehicles is depends on the area scenario so that the dynamic topology formation is done. The network is also controlled by some infrastructure devices. These devices are established on road side with sensing range specification. The RSUs (Road Side Units) are established to provide the controlled communication with utilization of restriction range communication [5].

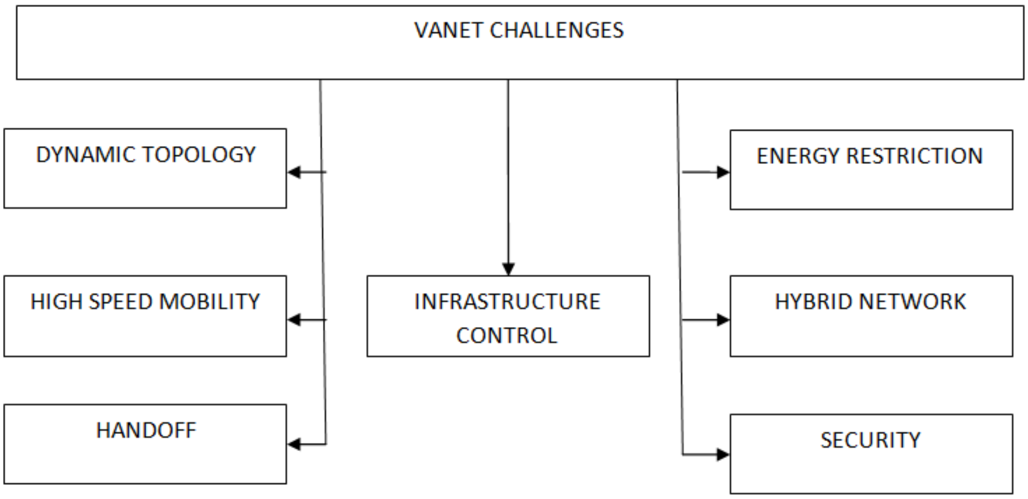

Figure 2. Challenges in VANET

The V2I and I2I communications are collectively formed to provide the utilization of available resources. Another property of vehicle nodes is the energy specification with each node. As the node participates in communication some amount of energy is consumed. The energy adaptive communication describes the network life and utilization of available battery. Another challenge in these networks is the variable and high speed mobility of vehicle nodes. The mobility is generally direction specific so that the predictive estimation and decisions can be taken to optimize the communication. Another challenge in mobile network is the hybridization of different network types and the associated technologies. Such as the same network can have Wi-Fi and WiMax adaptive base stations. A single node can be present in more than over network coverage at the same time. As of public network, the network suffers from various internal and external attacks. These attacks can degrade the network performance or can reveal the network information.

IV. FUZZY LOGIC

Fuzzy logic is a logic that deals with information of sets with no rigid boundaries, which are also called Fuzzy Sets. Fuzzy logic is a generalization of multivalued logics, which are generalizations of bivalent logics. While no degree of truth or membership is allowed in bivalent logics, only true or false is possible in multivalued logics to define the intermediate values. Linguistic variables ensure ability to express common measures in natural language formally. If then rules, which use linguistic variables, ensures a way to describe desired behaviours according to situations with associated imprecision. Knowledge to deal with known situation is modelled through this to automatic decision process. A knowledge database is a set of if-then rules, which using natural language describes all reactions a system must have when faced with specific situations. A fuzzy logic controller has 4 components: rule base, fuzzification, inference system and defuzzification. When activated at k-the instant, fuzzification interface translates numeric inputs e (k) and de (k) to fuzzy sets illustrating linguistic variables E and DE. Inference mechanism applies a predetermined linguistic rule set in rule base regarding linguistic variables produce the fuzzy sets of output linguistic variable DH. Finally, defuzzification Interface converts fuzzy results when inference mechanism reaches a numeric value dh (k)[6].

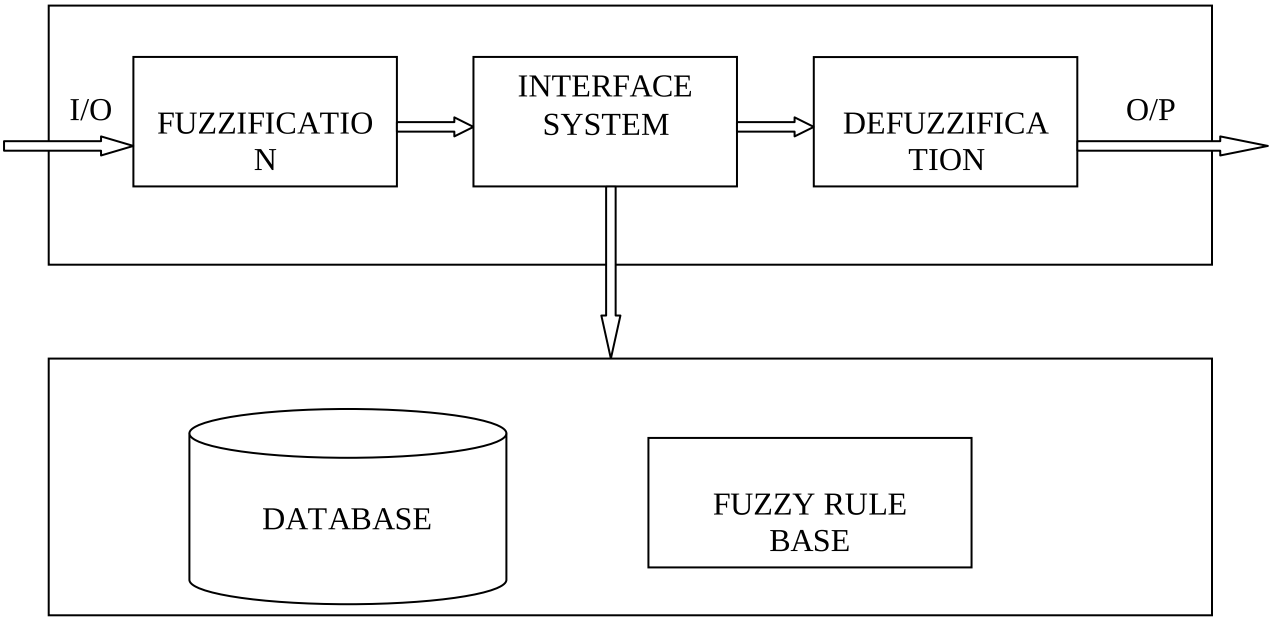

Figure 3. Fuzzy Rule-based system

Fuzzy rule generation methods are divided into 2 approaches based on strategies to divide input space into fuzzy subspaces. First is a grid-type fuzzy partitions based approach where each Input's domain interval is divided into antecedent fuzzy sets with linguistic labels. The second approach uses input space defined multidimensional antecedent fuzzy sets. A two-stage Fuzzy rule selection approach is proposed in literature review of [6]. Heuristic rule extraction is the first stage where a disciplined promising candidate rules are extracted from numerical data with a heuristic rule evaluation measure similar to data mining. The Evolutionary rule selection is the second stage where Evolutionary optimization algorithms find extracted candidate rules non-dominated subsets regarding accuracy and complexity [6].

V. ROUTING PROTOCOLS IN VANET

There are different routing protocols that are used for communication and data forwarding using wireless communication. Some of them are as follows:-

- **Topology Based Routing**
  - Proactive Routing(Table-Driven)
    - FSR, DSDV, OLSR, STAR
  - Reactive routing(on-demand)
    - AODV, PGB, TORA, DSR, JARR
- **Position Based Routing**
  - None-DTN
    - BEACON
    - NON- BEACON
    - HYBRID
  - DTN
  - HYBRID
- **Cluster Based Routing**
  - CBDRP
  - LORA-CBF
- **Geo-Cast Routing**
  - IVG
  - DG-CASTOR
  - DRG
- **Broadcast Routing**
  - DV-CAST
  - V-TRADE
  - UMB

VI. SUITABLE ROUTING PROTOCOL FOR VANET

Position based routing is the more suitable routing protocol in VANET environment. Here we study about various Position based routing protocols. Researchers in projects such as Flee Net [7], Car TALK 2000 [8] and now [9] have introduced and proposed the use of position based routing protocols.

Position-based routing that requires additional information has been founded to be more suitable for VANET environment. In this case the additional information required is the physical positions of the mobile nodes or vehicles, in order to perform data routing. This can be obtained via a Global Positioning System (GPS) with the assumption that the majority of vehicles in the future will have access to it, or by using other position determining techniques. A position-based routing protocol consists of multiple major components such as beaconing, location server, location service, forwarding strategy and recovery strategy. Beaconing is used to obtain the information of a node's neighbours whereas the location servers and location service are used to obtain the locations of destination nodes. The forwarding and recovery strategies are used to effectively forward packets from the source nodes to the destination nodes. Depending on the requirement, the use of some of these components are optional in certain position based routing protocols. One of the main advantages of using position based routing is that it's characteristic of not requiring maintenance of routes, which is very suitable for highly mobile networks such as in the VANET environment. The routing path is determined at the time when packets are required to be forwarded. Only the position of the destination as well as other information such as the node identifiers, forwarding nodes' and their neighbour's positions are required in order to forward information or packets from the source to the destination.

VII. POSITION BASED ROUTING IN VANET

For vehicular ad-hoc network environment, earlier research involved using strategies that incorporate the use of topology-based routing protocols as a replacement to the location services. For example, Schwingenschlogl and Kosch [10] introduced an AODV routing protocol that was enhanced with Geocast capabilities for vehicular networks. Geocast-based routing protocol also uses the knowledge of the geographic location similarly to position-based routing protocols. The difference is that Geocast-based routing focuses on sending messages or packets to a selective geographic region [11]. Research by Lochert et al and Mauve et al [13] then introduced routing strategies that used position-based routing together with a simple reactive location service (RLS). The concept of RLS [12] can directly be compared with the route discovery procedure used in reactive non-position based ad-hoc routing protocols such as AODV and DSR. The difference is that centers on vehicular ad-hoc networks for highway Environments while [13], focuses on vehicular ad hoc networks in city environments. The authors of [10] compared a position-based protocol extended with a simple RLS, with the topology-based routing protocol of DSR. In this case, the position-based routing protocol outperformed DSR. In [13] however, a new routing protocol called Geographic Source Routing (GSR) was proposed. Simulations were done using vehicular movement patterns of a certain part of the Berlin city, obtained using a traffic flow simulator. Comparing with the routing protocols of AODV and DSR, GSR surpassed them with respect to delivery rate and latency. For these approaches, changes have to be made to the topology-based protocols in order for the routing strategies to work properly.

Authors of [14] proposed a new position-based routing protocol called A-STAR which is for metropolis vehicular networks. The protocol adopts the anchor-based routing approach which is similar to GSR, with spatial awareness [15]. However, in this case the authors used the term 'street awareness' in order to precisely describe the use of street map information in their routing scheme. The protocol used the city bus route information in order to identify certain paths of higher connectivity so that more packets can be delivered to their destinations successfully. Besides that the authors also mentioned possible future work that involves using information on bus schedule in order to improve the performance of the A-STAR routing protocol.

In position-based routing, beaconing allows the interchange of various information between a node and its neighbors. However as discussed by authors in [16], due to the high mobility of the

VANET environment this beacon information might become invalid rapidly. Hence as part of the FleetNet project, [16] proposed a beaconless position-based unicast forwarding method by implementing Contention-Based Forwarding (CBF). Firstly, a packet is broadcasted to all of its immediate neighbors of the current node. Out of these neighbors, CBF then uses a biased timer based contention process in order to determine which of these nodes would be the next best hop. The selected node then suppresses the rest of the nodes from forwarding to avoid packet duplication. Simulated using three different suppression techniques, CBF outperformed a position-based routing protocol that uses beacon. With similar delivery rate achieved, CBF produced a lower load on the network.

Authors of [17] also proposed a beaconless routing strategy but for broadcasting purposes. The proposed Urban Multi-hop Broadcast (UMB) routing protocol for VANET has two phases which are directional broadcast and intersection broadcast. For directional broadcasting, the sender node attempts to find a node furthest away in the broadcast direction. This node will be chosen without using beaconing information, to forward packets. Intersection broadcasting functions to propagate packets in different directions of an intersection using repeaters or fixed infrastructures. Packets are propagated by the repeaters using directional broadcast. UMB was shown to perform well even in dense network with high network load.

Another position-based routing protocol that also requires fixed infrastructures was introduced by researchers of [18]. The difference is GVGrid uses these fixed infrastructures (as the source) to create routes on demand, to vehicles in the destination area. These fixed nodes also function to rebuild links that are broken due to mobility. GVGrid also focuses on providing Quos routing that will create routes with longer lifetime. To achieve this, the routing algorithms include information such as the vehicles speed and travel direction to predict vehicles movement. This information can be gathered from using digital maps and position information of vehicles. GVGrid was compared with GPCR that does not consider Quos routing. It was shown that although GVGrid has slightly higher packet arrival latency. It produced an overall longer route lifetime lower packet losses and lesser route disconnections [18].

Vehicles movement prediction was also incorporated into the improved Greedy Traffic Aware Routing (GyTAR) protocol [19]. Similar to other anchor-based routing protocols with spatial awareness GyTAR route packets between road junctions towards the destination. The difference is that the junctions are chosen on-the-fly taking into account the number of vehicles in between the junctions and the range to the next junction. This is done with the assumption that each vehicle has a built-in navigation system and is able to gather real-time traffic data. The packets are then forwarded between the junctions using a greedy strategy that selects the next hop based on predicted node locations. This is calculated using the vehicles travel direction speed and last known position. As for the recovery strategy GyTAR implements the method wherein a forwarding vehicle would hold the packets until the next best hop is reachable. GyTAR was shown to outperform GSR [13] in terms of packet delivery ratio packet latency and overhead packets.

GyTAR routing protocol showed an example of a carry and forward recovery strategy. Authors of [20] then introduced a store and forward strategy with the proposal of Static-node assisted Adaptive data Dissemination protocol (SADV) for VANET. Static Node Assisted Routing (SNAR) is one of the three modules in SADV and it requires a fixed infrastructure at each junction. Using SNAR the forwarding vehicle would hold a packet if the next best hop is not found (in the same and opposite direction). Once the packet reaches a junction the packet is stored in the installed static node until the best route to the next static node is available. The best route is measured by a delay matrix based on vehicle density calculated with the assistance of Digital maps and position information. The second SADV module is the Link Delay Update (LDU). LDU uses real-time traffic data to measure the delay matrix of links (from a static node) and disseminate this information to other static nodes. Overall SADV achieved its objective of improving the latency of packet delivery in medium and sparse networks.

The author of [3] proposed a fuzzy logic based greedy routing (FLGR) protocol. FLGR is used to select the next-hop forwarding nodes on the routing path through V2V communication processes. In FLGR, all the nodes in the network periodically broadcast the Hello packets. A sender node on receiving the Hello packet from the nodes in its transmission range R gets aware of its neighbors. Next, the current forwarding node (CFN) transmits a packet to a destination via intermediate nodes. Therefore, the CFN selects the best next-hop node among various other neighboring nodes from the right half of the circular region by employing the concept of fuzzy logic. During next-hop node selection process we consider two routing metrics such as distance of neighbor node from source, and position towards destination from source/CFN for each of the candidate neighbor nodes. Then apply distance metric and position metric to calculate the next node distance and next node position.

The author of [5] present a fuzzy adaptive model to provide efficient communication under DDOS attacks. Author proposed a two phase analysis In first stage, the region analysis is provided by the infrastructure device to analyze the region. This analysis is performed based on the density and distance parameters. These parameters are observed by the infrastructure device and the identification of effective communication region is done. In second phase of this work, the communication parameters are analyzed. The neighbor node election is performed based on the communication. The parameters considered for the analysis includes communication rate, loss rate and communication delay. These operators are analyzed collectively and the effective neighbor node is obtained. The process is repeated till the destination node not occurs.

VIII. CONCLUSION

In this review paper we studied various position based routing protocols which will help us to propose new routing protocols.

REFERENCES

1. Vehicle Safety Communications Project, Final Report, DOT HS 810 591, April 2006.
2. Nedal Ababneh and Houda Labiod. A performance Analysis of VANETs Routing Protocols Using Different Mobility Models. WCNIS2010 Conference.
3. Shilpy Agrawal , R. S. Raw , Neeraj Tyagi , A. K. Misra Fuzzy Logic based Greedy Routing (FLGR) in Multi-Hop Vehicular Ad hoc Networks ,november 2015.
4. Rahul raut parag thakare rahul bhoyar Conspectus of Various Routing Protocols in VANET april 2014
5. Jatin Malik, Rupali Malhotra , A Fuzzy Based Route Optimization model for QoS Optimization in VANET, July 2015.
6. P. Saravanan, T. Arunkumar Bee Optimized Fuzzy Geographical Routing Protocol for VANET in 2014.

7. FleetNet, "FleetNet - Internet on the Road," September 2000 [Online], Available: http://www.et2.tuharburg. de/fleetnet/, [Accessed: 2 May, 2008].
8. CarTALK 2000, "Safe and comfortable driving based upon inter-vehicle communication," August 2001 [Online], Available: http://www.cartalk2000.net/. [Accessed: 2 May, 2008].
9. NoW, "Network on Wheels," 2004 [Online], Available: http://www.network-on wheels.de/. [Accessed: 2 May,2008].
10. C. Schwingenschlogl and T. Kosch, "Geocast Enhancements of AODV for Vehicular Networks," ACM Mobile Computing and Communications Review, 6, 3, 2002, pp. 96-97.
11. C. Maihofer, "A Survey of Geocast Routing Protocols. IEEE Communications," Second Quarter, Vol. 6, No.2, 2004.
12. C. Lochert, H. Hartenstein, Tian, H. FiiBler, D.Herrmann, and M. Mauve, "A Routing Strategy for Vehicular Ad Hoc Networks in City Environments," In Proc. of the IEEE Intelligent Vehicles Symposium (lV2003), Ohio, USA, June 2003, pp. 156-161.
13. M. Kasemann, H. Fiif31er, H. Hartenstein and M. Mauve, "A Reactive Location Service for Mobile Ad Hoc Networks," Technical Report TR-02-014, Department of Computer Science, University of Mannheim, Nov. 2002.
14. G. Liu, B.S. Lee, B.C. Seet, et aI, "A Routing Strategy for Metropolis Vehicular Communications," ICOIN 2004, Nanyang Technological University, University of Edinburgh, 2004, pp. 134-143.
15. Tian, Han, and K. Rothermel, "Spatially Aware Packet Routing for Mobile Ad hoc Inter-Vehicle Radio Networks," In Proc. of the IEEE Intelligent Transportation System Conference (lTSC'03), 2003.
16. H. Fiif31er, H. Hartenstein, Widmer, M. Mauve and W.Effelsberg, "Contention-Based Forwarding for Street Scenarios," In Proc. of the 1st International Workshop on Intelligent Transportation (WIT), Hamburg, Germany, March 2004, pp. 155-160.
17. G. Korkmaz, E. Ekici, F. Ozgiiner and Ozgiiner, "Urban Multi-Hop Broadcast Protocol for Inter-Vehicle Communication Systems," First ACM Workshop on Vehicular Ad Hoc Networks (VANET 2004), Philadelphia, PA, USA, Oct, 2004.
18. W. Sun, H. Yamaguchi, K. Yukimasa, and S. Kusumoto, "GVGrid: A QoS Routing Protocol for Vehicular Ad Hoc Networks," IEEE IWQoS, 2006.
19. M. Jerbi, S.-M. Senouci, Y. G.-Doudane and R. Meraihi, "GyTAR: Improved Greedy Traffic Aware Routing protocol for Vehicular Ad hoc Networks in City Environments," Poster: The Third ACM International Workshop on Vehicular Ad Hoc Networks (VANET 2006), Los Angeles, CA, USA, Sep., 2006, pp. 88-89.
20. Y. Ding, C. Wang, and Xiao, "A Static-node Assisted Adaptive Routing Protocol in Vehicular Networks," In Proc. of the 4th ACM International Workshop on Vehicular Ad Hoc Networks, Montreal, Quebec, Canada, Sep., 2007, pp. 59-68.

