A Study of Geocast Routing Protocols in Vehicular Ad-Hoc Network (VANET)

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***Abstract*—** Geocast routing has been comprehensively investigated for consistent and well-organized spreading of information due to growing number of Intelligent Transportation System (ITS) applications favouring geocasting. Freshly, different geocast routing protocol have been developed in vehicular ad-hoc network (VANET). In this paper, a qualitative survey of recent geocast routing protocols and some specific future research issues in geocast routing have been provided. A practical and qualitative explanation of each considered protocols have been presented. All the considered protocols have been relatively characterized. This relative study leads us towards some future research challenges in geocast routing.

Keywords*—*ITS, VANET, Architecture of VANET, Protocols, Literature Survey

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I. INTRODUCTION

Vehicular Ad-Hoc Networking (VANET) is a modern concept, emerging as new research area which integrates three prior Communication research areas namely Ad-Hoc networks, Wireless LAN, Cellular telephony. The main purpose of the VANET is to improve the traffic safety and provides number of comfort application to travelling people. VANET is different from other kind of Ad-Hoc networks by their hybrid network architectures, high speed node movement characteristics and wide range of new comfort application possibilities. Therefore VANET poses a very unique networking research challenges and the design of routing protocols for VANET becomes a very crucial and important issue.

VANET enable new generation wireless capabilities to vehicles. The objective of VANET is to provide two key features:

1. Efficient vehicle to vehicle communication for providing ITS (Intelligent Transportation Systems) which includes Cooperative traffic monitoring, Control of traffic flows, Blind crossing, Prevention of collisions, real time rout computation.

2. Effective connectivity while on the road to high speed mobile users for providing various comfort like internet connectivity to download movies, play videos, and songs [1].

One of the earliest studies on VANET was started by Association of electronic Technology for automobile traffic and driving of Japan in the early 1980s.In 2000, the European project car-TALK tried to find out the problems related to the safe and comfort driving based on inter vehicle communication. Since 2002, with the rapid development of Wireless Technology, VANET emerged as a new research area. Various new workshops were organized to address research issues in this emerging area like ACM international workshop on Vehicular Ad-Hoc Networks from 2004 and International workshop on Intelligent Transportation from 2003.

On the other hand, several major automobile manufacturers have started investing in this research field. Audi, BMW, Daimler Chrysler, Fiat, Renault and Volkswagen have united to create a non -profit organization called Car2Car Communication Consortium (C2CCC) with the objective of further increasing the road safety and efficiency by means of inter vehicle communications. IEEE has also formed the new IEEE 802.11p task group which focuses on providing wireless access for the vehicle environment.

Due to high nodes mobility and unreliable channel conditions, VANET has its unique characteristics which pose many challenging research problems, such as data dissemination, data sharing and security issues. Data routing in VANET is a key networking problem because of high mobility of vehicles while most traditional sensor networks routing protocols focus on the stationary nodes. the main requirement of VANET routing protocol are to achieve dynamic changing topology and minimal communication delay with minimum consumption of network resources. Here I have discussed most recent research progress of routing protocols and their pros and cons are compared with the key performance matrices [2]

II. NETWORK ARCHITECTURES OF VANET

Network architecture of VANET falls into three categories:

a) Pure Cellular/WLAN: VANET uses fixed cellular gateways or WLAN access point at traffic intersection or besides road. Access point also plays the role of sinks for sensed information. Vehicles moves and connect to sinks when they enter into sink's signal transmission range. Moving nodes didn't have gateways capabilities [1] (cf. figure 1.1).

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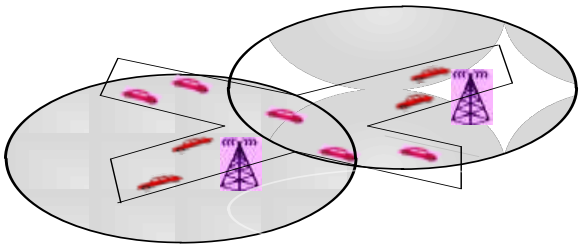

Figure 1.1 Pure Cellular Architecture of VANET

b) Pure Ad-hoc: all vehicles and road side wireless devices can form a mobile ad-hoc network to perform vehicle-to-vehicle communications and achieve certain goals such as blind crossing. In this category vehicles can work as gateways also [1] (cf. figure 1.2).

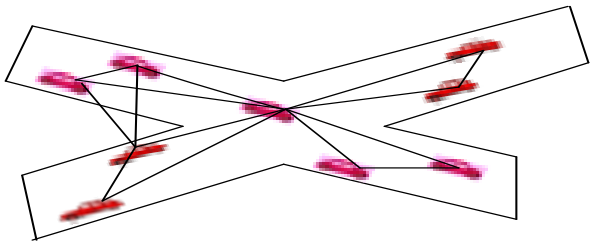

Figure 1.2 Pure Ad-hoc Architecture of VANET

c) Hybrid: It combines cellular, WLAN and Ad-Hoc networks together. It uses some vehicles with both WLAN and cellular capabilities as the gateways and mobile network routers so that vehicles with only WLAN capabilities can communicate with them through multi hop links, to remain connected to the world [2](cf. figure 1.3).

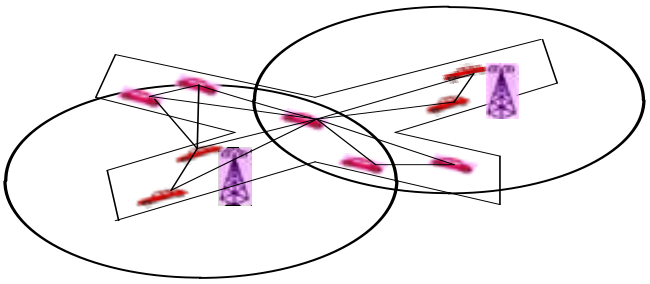

Figure 1.3 Hybrid Architecture of VANET

III. Routing Protocols

A routing protocol allows the communication to exchange information between two entities; it includes the procedure in establishing a route, decision in forwarding, and action in maintaining the route or recovering from routing failure. Routing Protocols are the major issue in VANET due to dynamic nature of vehicles. The basic aim of routing protocol is to attain the least communication time with low utilization of system resources. Routing in VANET can be unicast, multicast, geo cast, and broadcast. Routing protocols are divided into different categories [3].

A. Ad hoc Routing
B. Position based Routing
C. Cluster based Routing
D. Broadcast Routing
E. Geo Cast Routing

a) Ad hoc Routing: VANET network is same as MANETs. Ad-hoc On-demand Distance Vector (AODV) and Dynamic source routing (DSR) are used for MANETs. They both do not keep routes unless required. For AODV and DSR kind of protocol it is tricky to find out, update routes immediately in case of VANET because in vehicular network nodes move at high speed and also communication between changes one vehicle to another. So for VANET these protocols modify as PRAODV and PRAODVM. These protocols showed minor improvement but they depend on the correctness of predication method.

b) Position- based Routing: This type of routing is better than ad hoc Routing .It is based upon location information or information of position of street maps and traffic models in order to make routing decision. In this routing we discuss two scenarios one is city and other one is highway scenario. This routing is depends upon the forwarding decisions. One of the most important routing is Greedy Perimeter Stateless Routing [4].Greedy forwarding as explained as follows:

Figure 1.6 shows below Greedy forwarding technique as: x is the source vehicle and D is destination vehicle. Vehicle x wants to sends a packet to vehicle D. The area covered in red dotted circle shows the range of circle. Suppose circle covers five neighbours. Now x sends packet to the neighbour which has shortest distance to D among all other neighbours. Suppose y is the neighbour which has smaller distance to D than all other neighbour. However, x sends packets to y. This is called greedy forwarding. Now x sends packet to the neighbour which has shortest distance to D among all other neighbour. Suppose y is the neighbour which has smaller distance to D than all other neighbor. However, x sends packets to y. This is called greedy forwarding.

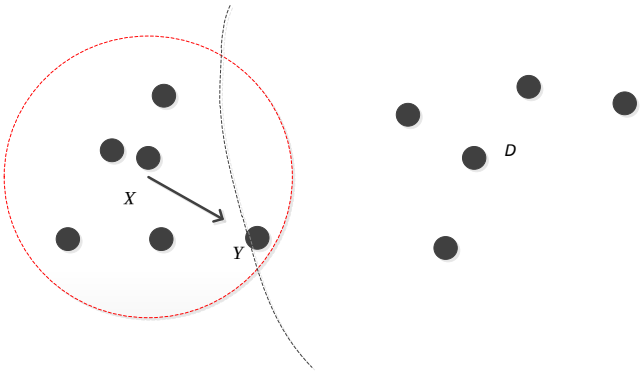

Figure 1.6 Example of Greedy forwarding

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There may be the case when no neighbour is close to destination vehicle D other than source vehicle x itself. At this point, greedy forwarding technique gets fail. So, a new greedy forwarding technique applied right hand thumb rule [1].

c) Cluster based routing: This type of routing creates a virtual network infrastructure in order to provide scalability. Figure shows the cluster based routing. In this routing each cluster has cluster head. There are two type of communication present in this routing. Inter and intra communication .In inter communication vehicle communicate directly with each other while in inter-cluster communication vehicle communicate via cluster head. Disadvantages of this routing are delay and additional overhead. Figure 1.7Shows multiple clusters in cluster based routing

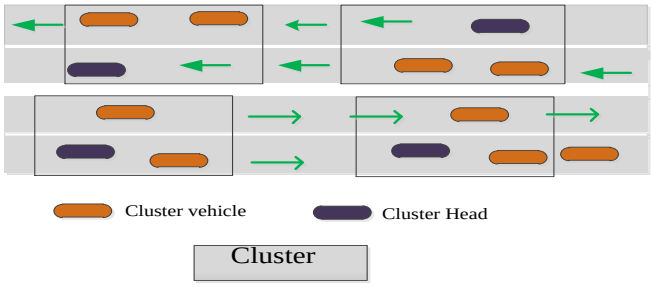

Figure 1.7 Cluster Based routing

d) Broadcast Routing: This routing is frequently used in VANET, such as traffic, climate, emergency situations and conditions of roads between different vehicles. This type of routing also has problem of overhead like cluster and ad-hoc routing protocols.

e) Geo cast Routing: Geo cast routing is location based multi cast routing. The main goal of this routing is to deliver the packet from a source vehicle to all the other vehicles within in a specified geographical region (Zone of Relevance, ZOR). Vehicles outside the ZOR are unable to avoid unnecessary and emergency reaction. Geocast routing is divided in three types: flooding, direct flooding, without flooding. As shown in figure 1.8

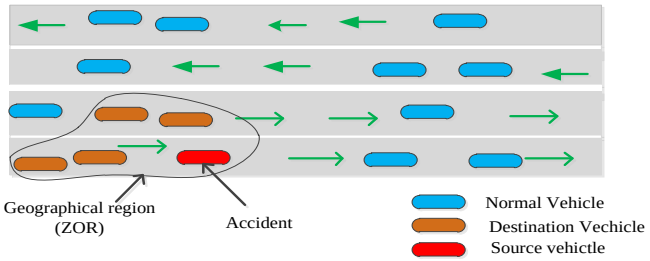

Figure 1.8 Geocast routing

IV. Literature Survey

A number of geocast routing protocols in VANET have been presented. Following we have discussed some of prominent geocast routing protocols with their pros and cons. BhaskarDas and Uptal Roy have presented a secured geocast routing in VANET [2]. They have presented a two stage efficient communication protocol. According to them process divided is two stages. In first stage nodes send message within transmission range and to VANET server. And in second stage VANET server transmit to all other nodes in geographical range. The purpose of this paper is to improve channel utilization and avoid loss of packets. From this protocol they have been found that bandwidth usage is less and enhance throughput. Andreasfestag have presented on design and performance of secure Geocast for vehicular communication [3]. In which he presented the design of a security solution which is based on various factors 1.Cryptographic protection, plausibility checks, mobility-related checks, trustworthy neighborhood assessment and rate limitation. His main concern is designed a security solution of vehicular communication for ad hoc and multi hop routing based on Geocast. His objectives for securing Geocast fall in three categories: function, performance, cost. Vivek Pathak, etc. all have designed geographical secure path routing (GSPR) to secure location aware services over vehicular ad-hoc networks (VANET) [4]. GSPR protects ad hoc network from faulty nodes. It routes the messages through anonymous nodes to destination. This Secure routing protocol also authenticates public keys and geographic location of destination node. GSPR uses geographic hashes, periodic beacons, geographic routing for malicious node detection. His protocol basically authenticated the routing paths taken by individual messages. A new scalable hybrid routing protocol has designed by Mohammad AI-Rabayah and Robert [5]. Their protocol combined a feature of reactive routing with location based geographic routing in manner that location information uses efficiently. The protocol is designed to gracefully exit to reactive routing as the location information degrades. They presented that even in the presence of error HLAR is simple to deploy and obtains optimal scalability performance. Next one, dynamic time–stable Geocast Routing technique (DSTG) have been presented by Hamidreza Rahbhar, et.al [6].They have designed DTSG that guarantees to deliver of the message to the intended vehicles when they are entering the region for a certain amount of time. DTSG is a time stable Geocast protocol that works with sparse network. In some applications like commercial it is necessary have the duration of stable messages within the region, so this protocol allows this time to be extended, reduced, or cancelled without any additional cost. This protocol works in two phases: pre stable period and stable period. In pre stable period messages are transmitted in within the region. In stable-period messages alive during the desired time within the region. In this intended vehicle (helping vehicle) has received a message in its stable period then it is rebroadcast it after a proper sleep time until they enter end of the region or they enter the extra length region. They stop rebroadcasting when they have received at-least one acknowledgment from other lane. Dynamic time–stable Geocast Routing technique (DSTG) was presented for Highways which has only few entries or exit. But most of the

vehicle covers the urban environment. For this kind of scenario a new time stable protocol has been suggested T-TSG traffic light based time stable Geocast routing technique by Omprakash Kaiwartya, et.al [7].It is a three phase routing approach based on traffic behavior. It is based upon on four concepts: 1. Identification of geo cast region from region of interest (ROI): It is depend on from where incident happens or warning messages originated. 2. Selection of forwarding Vehicles: It is depend on traffic light and direction of vehicles. 3. Geocast Message Stable Region (GMSR) and Stable Vehicle Region (SVR). 4. Three phases concept: Forwarding, Disseminating and Re-Live (FDRL)

V. CONCLUSIONS

In this paper, we will conclude our proposed work with findings and observations. We will also discuss some future research direction of our proposed work.

REFERENCES

[1] Rakesh Kumar, Dr. Mayank Dave "Mobile Agent as an Approach to Improve QoS in Vehicular Ad Hoc Network" IJCA Special Issue on "Mobile Ad-hoc Networks" MANETs, 2010

[2] Fan Li; Yu Wang, "Routing in vehicular ad hoc networks: A survey, "Vehicular Technology Magazine, IEEE, vol.2, no.2, pp.12, 22, 2007.

[3] Samara, G.; Al-Salihy, W.A.H.; Sures, R., "Security issues and challenges of Vehicular Ad Hoc Networks (VANET)"New Trends in Information Science and Service Science (NISS), 2010 4th International Conference on, vol., no., pp.393-398, 2010.

[4] Ghafoor, H.; Aziz, K., "Position-based and geo-cast routing protocols in VANET," Emerging Technologies (ICET), 2011 7th International Conference on, vol., no., pp.1-5, 2011.

[5] B.Karp and H.T, Kung, "GSPR Greedy perimeter stateless routing for wireless networks," in Proceedings of the ACM/IEEE, International Conference on Mobile Computing and Networking, Boston ,Massachusetts, pp. 243-254,2000.

[6] Bhaskar Das and Utpal Roy. "Article: Secured Geocast Routing in VANET (Vehicular Ad-Hoc Network)with two Stage Efficient Communication Protocol," International Journal of Computer Applications, vol.53, no.12, pp.34-38, 2012.

[7] Festag, A. Papadimitratos, P. Tielert, T., "Design and Performance of Secure Geocast for Vehicular Communication, "Vehicular Technology, IEEE Transactions on, vol.59, no.5, pp.2456-2471, 2010.

[8] Pathak, V.; Danfeng Yao; Iftode, L., "Securing location aware services over VANET using geographical secure path routing," Vehicular Electronics and Safety", 2008. ICVES 2008. IEEE International Conference on, vol., no., pp.346-353, 22-24, 2008.

[9] Al-Rabayah, M.; Malaney, R., "A New Scalable Hybrid Routing Protocol for VANET," Vehicular Technology, IEEE Transactions on, vol.61, no.6, pp.2625-2635, 2012.

[10] Rahbar, H.; Naik, K.; Nayak, A., "DTSG: Dynamic time-stable geocast routing in vehicular ad hoc networks," Ad Hoc Networking Workshop (Med-Hoc-Net), The 9th IFIPAnnual Mediterranean, vol., no., pp.1-7, 2010.

[11] URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5546872&isnumber=5546845

[12] Kaiwartya, Omprakash; Kumar, Sushil; Kasana, Reena, "Traffic light based time stable geocast (T-TSG) routing for urban VANET," Contemporary Computing (IC3), 2013 Sixth International Conference on , vol., no., pp.113,117, 8-10 Aug. 2013.

[13] Young-Baeko, Nitom h. Vaidya "Flooding-Based Geocasting Protocols for Mobile Ad Hoc Networks" Mobile Networks and Applications, pp. 471–480, 2002
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