

Geocast Routing in Vehicular Ad Hoc Networks: A Survey

Seema Kamboj¹, Sunil Chawla¹

¹ *Department of Computer Science & Engineering,
Haryana College of Technology & Management,
Kaithal*

Abstract:- Vehicular ad hoc network is an emerging technology ad hoc network integrating ad hoc network, wireless LAN & cellular technology to improve road safety. Geocast routing has been provided information due to increasing number of intelligent transport system (ITS) applications favoring geocasting .various geocast routing Protocol have been developed . In this paper, a survey of geocast routing protocols and some future research issues in geocast routing have been provided. All the considered protocols have been comparatively characterized. This study leads us towards some future research challenges in geocast routing vehicular ad-hoc network (VANET) information services.

Keyword:- Geocast routing , vehicular ad-hoc networks , VANETs survey

[1] INTRODUCTION:-

Traffic casualties have been long standing problem, as in the rest of the world .As an indication of the acuteness of the problem, in 1999 there were 6,279,000 vehicle accidents that considered for 41,611 deaths in the United States [1].Large volume of road traffic is an inconvenient for people. The road traffic conditions affect the safety of the population around 40,000 people die and more than millions are offended every year on the roads. Besides, traffic jams generates huge waste of time and fuel affecting to the economy and increasing the environmental impacts of surface transportation travel. So advances in ad hoc wireless technology give ascent to the evolution of vehicular ad hoc networks (VANETs).Vehicular ad hoc networks (VANETs) represent a rapidly emerging research field and consider essential for cooperative driving among vehicles on the road. Vehicular Ad-Hoc Networks (VANETs) is a recent concept, evolving as new research area which includes three earlier communication research areas namely Ad-Hoc Networks, Wireless LAN, and Cellular Telephony [2].The era of vehicular ad hoc networks (VANETs) is now evolving, gaining attention and momentum .Intelligent Transportation Systems (ITS) is the major application of VANETs. ITS includes a variety of applications such as co-operative traffic monitoring, blind crossing, prevention of collisions, control of traffic flows nearby information services. Another important application for VANETs is providing Internet connectivity to vehicular nodes while on the move, so the users can download music, send emails [3].

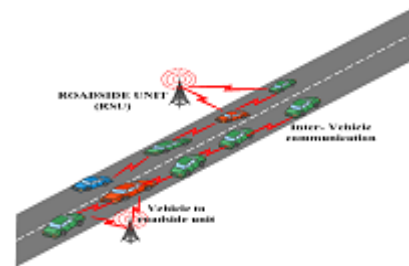


Figure 1.1:- Vehicular ad hoc network

VANET is a subset of Mobile Ad hoc Networks (MANETs) that uses moving cars as nodes in a network to create mobile networks; every node can move freely within the network coverage and stay connected with each other. In this network, vehicles can be vehicles or Road Side Units (RSU) and they can communicate with other vehicles in single hop or multi hop. In figure1 shows vehicular ad hoc network. However VANET is differentiated from MANET by many aspects such as dynamic topology changes and high mobility of the nodes VANETs are distinguished from other kinds of ad hoc networks by their hybrid network architectures, highly dynamic topology, frequently disconnected network, Geographical type of communication and etc [4].Various forms of wireless communications technologies have been proposed for deploying VANETs. Currently, Dedicated Short-Range Communication (DSRC), which is an enhanced version of the Wi-Fi technology suitable for VANETs environment. It allows data exchange between high speed vehicles and the roadside or between vehicles, for ITS.IEEE 802.11pwas also considered for DSRC which is a wireless communication protocol particularly designed for VANETs. However, cellular networks validate appropriate voice communication and simple infotainment services to drivers and passengers; they are not convenient for direct vehicle-to-vehicle or vehicle-to-infrastructure communications. However, vehicular ad hoc networks (VANETs) offer direct communication between vehicles and vehicles and roadside units (RSUs). With the availability since the late 1990s of economical, global-positioning system (GPS) receivers and wireless local area network (WLAN) transceivers, research in the arena of inter-vehicular communication attained extensive strength [5]. Due to direct communication vehicular ad –hoc networks is used more as comparison to cellular network.

By using vehicular ad-hoc network we give direct information to vehicle to vehicle. By GPS system vehicles easily find the position of the vehicle. Now days wireless network use increase in vehicular ad – hoc network for getting more services.

[2] GEO-CAST ROUTING IN VANET [6]:-

It is basically location based multicast routing. The objective of geo-cast routing is to deliver packets from source node to all other nodes within a specified geographical region, also called Zone of Relevance.

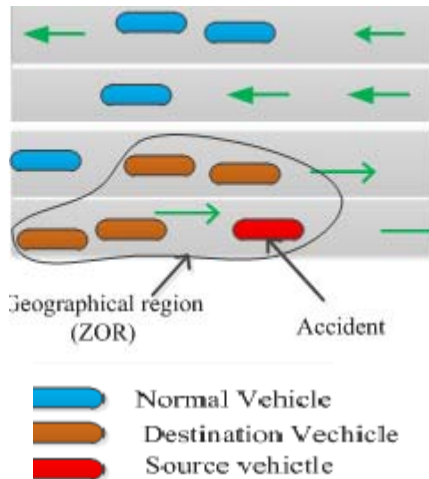


Figure2.1: -Geo-Cast Routing

[2.1] Initial Efforts towards Geocasting: -

The first idea of geocast goes back to attempt to relate IP address to geographic locations in the UUMAP project. The project maintained a database in which geographic locations of internet host were stored. Later two similar projects tried to relate DNS names to geographic locations. They extended the DNS data structure with geographic longitude and latitude information, which makes it possible to return geographic location of a host based on IP address or DNS names. However, both these approaches were notable to support the reverse function, that is, they were not able to return the IP address or DNS name based on geographic information.

Therefore, such systems made it possible geographic destination location was first presented in Cartesian Routing. Cartesian Routing uses latitude-based and longitude-based addresses. Each network node, that is, source node, destination node, or intermediate node, knows its geographic address and the geographic addresses of its directly connected routers to relate data flows with geographic areas, but they were unsuitable to direct data flow to a given geographic area. Routing packets to a geographic destination location was first presented in Cartesian Routing. Cartesian Routing uses latitude-based and longitude-based addresses. Each network node, that is, source node, destination node, or intermediate node, knows its geographic address and the geographic addresses of its directly connected routers.

[2.2] Geocast Routing Motivation:- Emerging inter - vehicles communication based on mobile networks has

sparked considerable curiosity about the intelligent transport systems (ITSs). Wireless ad-hoc network communication plays a vital role in ITS. By using the global positioning system (GPS), VANETs have overcome the limitation of traditional systems, like radar and video cameras and make possible more advanced services in ITS. Most of the ITS services require sending messages to all nodes in a certain geographical area, called geocasting, a subclass of multicasting. Unlike multicast, which sends a packet to arbitrary nodes, geocast enables transmission of a packet to all nodes within a pre-defined geographical region. The goal of geocasting is to guarantee delivery while maintaining a low cast [7]. In vehicular ad-hoc networks, the major challenge for routing protocol is to find a route from the sender to the destination without any preconfigured information and under constantly varying link circumstances. Topology based routing is strictly avoided because of dynamic changes in topology. The approach of position based routing relies only on geographic position information to deal with the problem of dynamic topology changes. This means, that all routing decisions, to which node packet should be forwarded, are based on the geographic destination data that is included in the packet. Position based routing is a suitable candidate for vehicular ad-hoc networks since position information is already available from navigation systems [8].

[2.3] Different Techniques of Geocast Routing [9, 10]:-

There are three different techniques of geocast routing: Routing with simple flooding, direct flooding and no flooding.

a) **Simple Flooding:-**

This algorithm works: vehicle relays a received packet to all neighbours vehicle. In order to avoid loops and endless flooding, this packet was not already received before. A vehicle broadcasts a packet if the own whereabouts is within the specified destination province, which is comprised in each geocast packet. This is a straight forward and resilient but not efficient approach .direct flooding trying to limit the message overhead and network congestion. In this flooding whole the network without trying to limit the flooding area. But we are trying to limit the message overhead and network congestion by applying the forwarding zone. but forwarding zone protocol is different from the direct forwarding method. so we use direct flooding and simple flooding with routing.

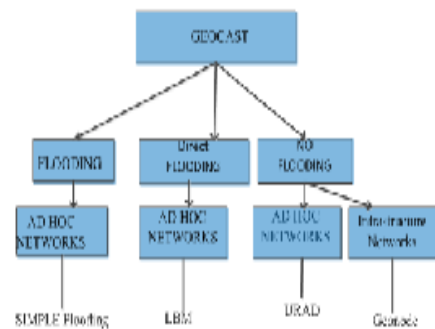


Figure2.2:-Geocastrouting taxonomy

b) Routing with Directed Flooding:-

In Location based multicast (LBM) algorithm, a forwarding of packet is describing by specified vicinity called "Forwarding Zone". Simple Flooding is altered by defining a forwarding zone that includes somewhat the destination region and a path between the sender and the destination region. An intermediate node forwards a packet only if it resides to the forwarding zone. Overhead is increased, by increasing the forwarding zone because the probability for reception of a geo cast packet at all destination nodes could be increased. Two types of forwarding zones are described. One is the rectangular forwarding zone and the other one is distance-based forwarding zone as shown in figures 2.3 respectively. In the rectangular type, the vehicles that are inside the forwarding zone forward the packets only. If the packet is delivered to the vehicles that are outside the forwarding zone, the packet is discarded. In Second Distance based type, the distance is measured from the sender to the centre of destination region. The vehicles having distance less than this distance from source to the centre of destination region is used in broadcasting, otherwise the nodes with larger distance drop the packet as shown below.

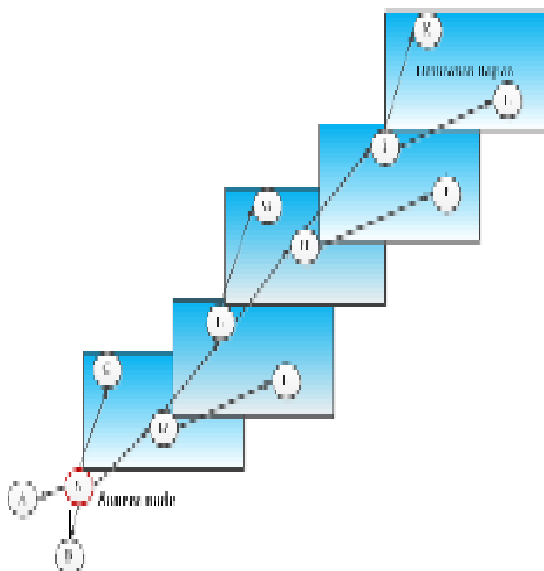


Figure 2.3:- Rectangular Forwarding zone

c) Routing with Flooding:-

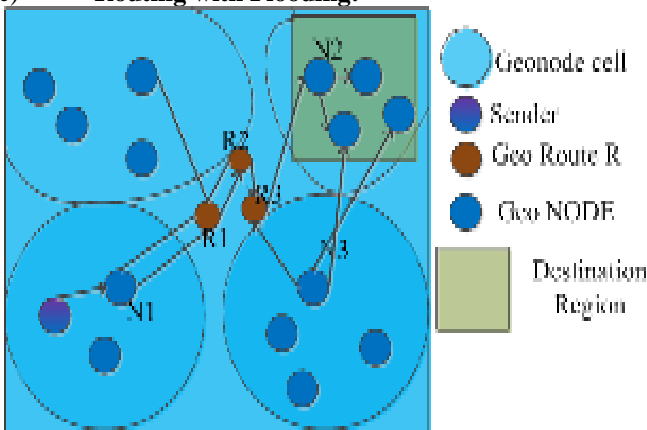


Figure 2.4:- Geocast example with GeoNode

It is also called Geonode. Geo Node encompasses an infrastructure system. In this advent, there are three basic essentials: Geo-Node, Geo- Router Geo-Host. Each Geo-Router has a circular range. The transmission of packet in this advent is completed by multicast routing. In figure the packet is sent to N1 by the source S. N1 forwards the packet to its router R1. Now according to the circular range of router, the destination region is covered by R3, so R1 forwards the packet to R2 from where it is forwarded to R3. R3 delivers it to N2 and N3, both of which interconnect with the destination region.

[2.4] Geocast Routing Protocols in VANETS: -

The present Geocast routing protocols in VANETS IVG, Cached Geo cast, DRG, DTS, Abiding Geocast, ROVER, DG-CASTOR, Mobicast, Constrained Geocast , Geo cache.

i. Inter-Vehicular Geocast (IVG) protocol: -

The motive of IVG is to notify vehicles located in a likelihood area called multicast group about any danger on the highway (e.g., when a catastrophe occurs). To procure this goal, risk area is determined considering the precise obstacle location on the road and the driving directions which can be affected. The damaged vehicle transmits a message alert to the multicast group. The neighbours receiving the message test its relevance according to their location by report to the likelihood area. All the neighbours belonging to the likelihood area calculate a differ time back-off that promotes the furthest node to be a relay to re transmit the message This relay selection technique make the use of periodic beacons unnecessary .so by this protocol we got the message alert and protect the other vehicle location. This protocol use for the protecting the vehicle tells about the danger before. so we find the location of the risk area.

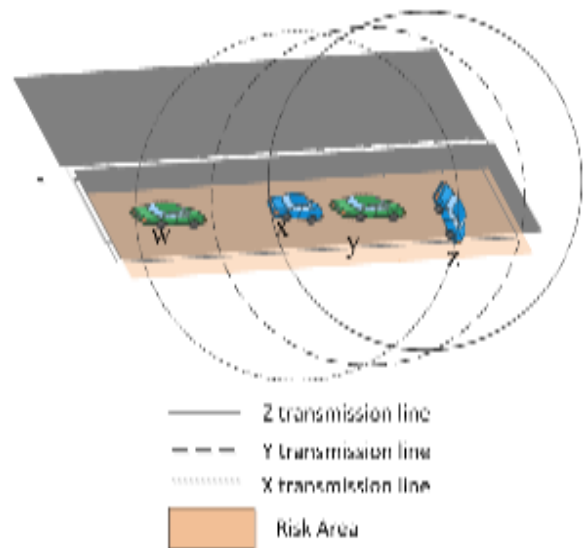


Figure 2.5:- IVG Relay selection: x is more distant to z then y. x is a relay. x permits to reach w while y not.

Cached Geocast:-Maihofer and Eberhard's scheme add a small cache in routing layer which is used to hold those packets that can't be forwarded instantly due to 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 known neighbours change their positions; the cached message is forwarded to newly discovered nodes. It always chooses greedy distance approach to forward packet towards destination. It is good at abating system latency but with the increase of network topology, data forwarding loop creates problems.

Abiding Geocast :-In this protocol, packets need to deliver all nodes that are inside the geocast destination region during the geocast lifetime (a certain period of time) .It uses three approaches for forwarding messages :Server approach, election approach and neighbour approach .Three solutions are provided.

First, the use of a server that keeps Geocast message. Then the server uses a Geocast protocol to deliver periodically the Geocast message to the destination zone. Secondly, in the relevant destination area a node is elected in order to store the Geocast message and retransmit it periodically or by notification. Third, the neighbour approach includes, allowing all nodes to store the Geocast message. For VANETs, the use of abiding Geocast is appropriate for some applications as following:

The use of the server approach for information, advertising applications and inform drivers about the conditions of the road e.g., accident event, slippery surface, ice storm, etc. Elected node and neighbour approach are more rework to safety applications to notify drivers about an accident on their direction.

Reliable Geographical Multicast Routing:-M.Kihl et. al. proposed this technique ROVER. ROVER assumptions are:-

- ❖ Each vehicle is recognized by an Identification Number
- ❖ Each vehicle is equipped with GPS receiver
- ❖ Vehicles have access to a digital map
- ❖ ZOR is a rectangle area
- ❖ ZOF including the sender and the ZOR .

The aim of ROVER is to broadcasts application generated message application to all vehicles located into the defined. It defines a message as a triplet [Application message, ZOR]. A vehicle accepted a message if it belongs to the message's ZOR.

DG-CastOR:-Atechian and al. proposed a Geocast routing protocol based on link availability estimation that is DG - CastOR. The main concept of this routing protocol is to determine the neighbors that will have the same direction with the sender during a period of time, based on spatio temporal similarity measures.

Linda bariesemeisteretal's Protocol: - In this protocol when a node receives a packet, it does not forward it immediately but waits for some duration according to following formula.

$$WT(d) = -\frac{MaxWT}{Range} \cdot \hat{d} + MaxWT$$

Where, *Max WT*= Maximum Waiting Time

Range = Transmission range

d= Distance from sender

\hat{d} = min {*d*, range}

The waiting time is inversely proportional to the sender's distance from current node. When, this waiting time expires and the current node does not receive same message from other neighboring nodes then the current node rebroadcasts the message. It improves the system reliability but increases system delay .so we can do more work for reducing the system delay. Future work will be done easy to reduce the system delay && give the better performance.

In the all geocasting protocol there are some limitations and advantages. So for the safety applications all the geocasting protocol used. Basically routing protocol which are used in vehicle ad hoc networks are:- Ad-hoc routing , position based routing , cluster routing , broadcast routing, geocast routing . But geocast routing is best in all the routing that why we are preferring geocast routing. Because geocast routing is location based multicast routing. In geocast routing location is preferred. In geocast routing message are sends in packets for all the vehicle in geographical region. A securing Geocast fall in three categories: function, performance, cost . Vivek Pathak, et.al have designed geographical secure path routing (GSPR) to secure location aware services over vehicular ad-hoc networks (VANET). 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 time stable protocol has been suggested T-TSG traffic light based time stable Geocast routing technique by Omprakash Kaiwartya, et.al .It is a three phase routing approach based on traffic behaviour. 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). So geocasting routing give us more future research in the coming years.

[3] RELATED STUDY:-

VANETs Project in different countries:		
EUROPEON UNION		
PROJECT	Time /period	GOAL
COOPERS (Cooperative Systems for Intelligent Road Safety)	Start : February 2006 Duration : 4 years	It is for “Co-operative Traffic Management” between vehicle and infrastructure. The aim of the project is the improvement of road safety.
CVIS (Cooperative Vehicle-Infrastructure Systems)	Start: February 2006 Duration: 4 years	It is for wide range of potential cooperative services to run on an open application framework in the vehicle and roadside equipment It addresses issues such as end user acceptance, data privacy and security, system openness and interoperability, risk and liability, public
PREVENT	Duration: 2004-2008	It helps drivers to avoid or mitigate an accident through the use of in-vehicle systems helps technological development and integration as well as decrease component costs.
CARTALK	Start: 2000	development of co-operative driver assistance systems and evolution of a self-organizing ad-hoc radio network as a communication
C2CCommunication Consortium	Start: Summer 2002	<ul style="list-style-type: none"> ➤ Development and release of an open European standard for cooperative Intelligent Transport Systems. ➤ To provide its specifications and contributions ➤ To the standardization organizations in order to achieve common European standards for ITS.
USA		
IVI (Intelligent Vehicle Initiative)	Start: 1998 Duration: 6 years	It helps to prevent or reduce the severity of Crashes through technologies that help drivers to avoid hazardous mistakes. <ul style="list-style-type: none"> ➤ Develops technology to assist in preventing driver distraction.
VSC (Vehicle Safety Communications)	Start: 2002 Duration: 2 years	<ul style="list-style-type: none"> ➤ Determine the minimum system requirement and associated performance parameters for vehicle safety applications operating in conjunction with this DSRC system.
Wireless Access in Vehicular Environments (WAVE)	Start: 2004 Duration: 3 years	WAVE is required to support the Intelligent Transportation Systems (ITS) applications in the short-range communications
JAPAN		
Demo	2000	<ul style="list-style-type: none"> ➤ It narrated a demonstrations of a cooperative driver assistance system
Advanced Safety Vehicle Program(ASV-2) (ASV-3) (ASV-4)	ASV-2 : 1996–2000 ASV-3 : 2001–2005 ASV-4: 2005–2007	The aim of these programme was to develop Methods and devices to improve the safety of the transportation system .The Japanese automobile manufacturers (Daihatsu, Honda, Isuzu, Mitsubishi, Nissan, Subaru, Suzuki, Toyota) participated in the programme and developed demonstration vehicles.

[4] CONCLUSION: -

In this paper, we discuss about VANETs, its evolution and its project on different countries. Table 1 summarizes the project in different countries. In general, geocasting routing is more promising than other routing protocols for VANETs because of the geographical constrains. Security

is also an important issue for routing in VANETs, because many applications will affect life-or-death decisions and illicit tampering can have devastating consequences. The characteristics of VANETs make the secure routing problem more challenging and novel than it is in other communication.

REFERENCES: -

1. Federal Communications Commission. Amendment of the commission's rules regarding dedicated short-range communication service in the 5.850-5.925 GHz band, FCC 02-302. Tech.rep.FCC, November 2002.
2. Karagiannis, G., Altintas, O., E., Heijenk, G., Jarupan, B., Lin, K. & Weil, T. Vehicular Networking: A Survey and Tutorial on Requirements, Architectures, Challenges, Standards and Solutions. Communications Surveys & Tutorials, IEEE, 13(4), 584-616, 2012.
3. Fan Li and Ya Wang, "Routing in Vehicular Ad-Hoc Networks: Survey" IEEE Vehicular Technology Magazine-I June 2007.
4. Junyi, Li. Wodczak, M., Xinzhou,Wu.&Hsing, T.R., Vehicular networks and applications: Challenges, requirements and service opportunities. Computing, Networking, Communications (ICNC), International Conference on, IEEE, 1(1), 660-664, 2012.
5. Hartenstein, H.; Laberteaux, K.P., "A tutorial survey on vehicular ad hoc networks," Communications Magazine, IEEE, vol.46,no.6, pp.164,171,doi: 10.1109/MCOM.2008.4539481, June 2008.
6. Christian Maihofer, "A survey on geocast routing protocols," IEEE communications Surveys and Tutorials, 2nd quarter, 2004.
7. Lope J. G. B. "A Survey of Geographic Routing Protocols for Vehicular Ad Hoc Networks (VANETs)", New Mexico State University, pp. 1-15, 2010.
8. S. Dornbush and A. Joshi, "Street Smart Traffic: Discovering and disseminating automobile congestion using VANET," In IEEE Vehicular Technology Conference, 2007.
9. Hamidreza Rahbar, Kshirasagar Naik and Amiya Nayak, "Dynamic time stable geocast routing in vehicular ad-hoc networks," IEEE, 2010.
10. Ghafoor, H.; Aziz, K., "Position-based and geocast routing protocols in VANETs," Emerging Technologies (ICET), 2011 7th International Conference on , vol., no.,pp.1,5,5-6Sept.doi: 10.1109/ICET.2011.6048483,2011.