International Journal of Research in Engineering, Science and Management
Volume-2, Issue-2, February-2019
www.ijresm.com | ISSN (Online): 2581-5792


# A Review on Routing Protocols in VANET

V. Praveen Kumar[1], V. Thamizharasi[2]
[1]*Lecturer, Dept. of Electronics and Communication Engg., Government Polytechnic College, Trichy, India*
[2]*Sr. Grade Lecturer, Dept. of Electronics and Communication Engg., Govt. Polytechnic College, Trichy, India*

***Abstract*: Vehicular Adhoc Networks (VANETs) provide a promising approach for an Intelligent Information Transportation System. Several Routing protocols are used in VANETs for Communication in Vehicles to Vehicles (V2V) and Vehicles to Infrastructure (V2I) networks. These routing protocols for VANETs are classified as unicast, broadcast and multicast. Based on this strategy VANET routing protocols are comparing using following parameters namely route discovery, forwarding strategy, no of transmission, etc.**

***Keywords*: Broadcast based, Multicast based, Position based, Routing Protocols, VANET.**

## 1. Introduction

Vehicular Ad Hoc Networks (VANETs) interact among themselves to avoid critical situations such as road side accidents or traffic jams. VANETs can also be used for speed control, free passage of emergency vehicles and identifying obstacles, etc., this is achieved with the help of sensors embedded on the vehicle. Road Side Units (RSUs) such as Cellular base for data distributions with Vehicles cannot use of central access-points. The mobile nodes are generally constrained to roadways, and so they have a distinct controlled mobility pattern. VANET can be utilized for a broad range of safety and other applications that allow value added services such as vehicle safety, automated toll payment, traffic management, enhanced navigation, location based services such as finding the closest fuel station, hospital etc.,. The following fig. 1, shows the communication between V2V and V2I.

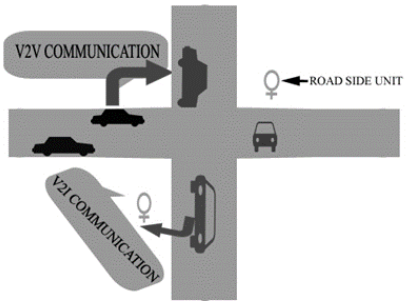


Fig. 1. Communication in V2V and V2I

Those routing protocols are classified and shown in fig. Topology based routing protocols and their types are deal in Section 2. Position Based routing protocols are explained in Section 3. Broadcast based routing protocols are discuss in Section 4. Multicast based routing protocols are further classified and explain in Section 5. The Comparison of protocols are tabulated in Section 6 and Finally Section 7 concludes the review work.

## 2. Topology based routing protocol

Topology based protocol has a shortest route from source to destination. This protocol is used to link information within the network. That link information's are stored in the routing table for forwarding a packet. It supports unicast, multicast and broadcast messages. It has less resource consumption and save bandwidth. This protocol is furthered enhanced to discover and maintain route delays and to avoid unnecessary flooding. The works carried out on Topology based routing protocols by Chandel et al., 2014, Paul et al., 2012 and kaur et al.,2012 are analyzed and classified topology based routing protocol as proactive, reactive and hybrid [3]-[5].

### *A. Pro-Active (Table Driven)*

It keep all the information of connected nodes in form of tables. They are table based. These tables are shared by neighbors. Example Protocols: DSDV, OLSR, FSR, LOUVER, TBRPF.

- *Destination Sequence Distance Vector routing(DSDV)*- Destination Sequence Distance Vector Routing (DSDV) is make available loop free routes, use single source to destination, and use distance vector shortest path algorithm. Two types of packets are sending the protocol i) incremental and ii) Full Dump. In full dump type packets are sending with routing information, and in incremental packet send the updates. Full dump packets are decreases the bandwidth and the incremental packets are so frequent and increase the overhead in networks. DSDV protocols are not suitable for large networks due to utilizing the bandwidth and updating procedures.
- *Optimized Link State Routing (OLSR)*-This protocol is based on the traditional link-state algorithm. It is using a technique called multipoint relaying for optimized message and flooding process for route setup or route maintenance. The algorithm minimizes the number of active relays for covering the neighbors. The protocol introduced for accuracy and stability for routing the data in network. The major advantage of this protocol

| ROUTING PROTOCOLS IN VANET | | | | | | |
|---|---|---|---|---|---|---|
| UNICAST BASED | | | | BROADCAST BASED | MULTICAST BASED | |
| TOPOLOGY | | | POSITION | 1. BROAD-COMM<br>2.EAEP<br>3. DV-CAST<br>4. SRB<br>5.PBSM<br>6.PGB<br>7.UMB<br>8.DECA<br>9.V-TRADE | CLUSTER | GEOCAST |
| PROACTIVE | REACTIVE | HYBRID | 1.GPSR<br>2.GPCR<br>3.CAR<br>4.GSR<br>5.A-STAR<br>6.STBR | | 1.HCB<br>2.CBDRP<br>3.CBLR<br>4.CBR<br>5.LORA-CBF<br>6.COIN<br>7.TIBCRPA | 1.IVG<br>2. ROVER<br>3.DTSG<br>4.CASHED<br>5.ABIDING<br>6.DG-CASTOR |
| 1. DSDV<br>2. OLSR.<br>3. FSR<br>4.TBRPF | 1.AODV<br>2.DSR<br>3.TORA | 1.ZHLS<br>2.ZRP<br>3.HARP | | | | |

is the all routes and destinations are known and maintained before the operation. On the other hand, the nodes are moving fast, due to calculation of optimal node may be impossible in some cases.

- *Fisheye State Routing (FSR)* based on link state routing and an improvement of global sate routing. It reduces the size of updating message. For large networks scalability is the main problem. Due to scalability, the accuracy is not sufficient and it increases the network size. In Fisheye state routing protocol (FSR) the target node lies out of scope then route discovery fails.
- *Topology Dissemination Based on Reverse*-Path Forwarding (TBRPF) - It is a link-state routing protocol designed for ad-hoc networks. Every node constructs a source tree which contains paths to all reachable nodes by using topology table. Nodes are periodically updated with only the differences between the previous and current network state using HELLO messages. Therefore, routing messages are smaller, can therefore be sent more frequently to neighbors.

### *B. Re-Active*

It is called on demand routing because it starts route discovery when a node needs to communicate with another node thus it reduces network traffic. Example Protocols: AODV, DSR, TORA.

- *Adhoc On demand Distance Vector (AODV)* - This protocol establish a route when a node sending data packet. It has the ability of unicast & multicast. AODV protocol is different from other on demand routing protocols by providing Destination Sequence Number (DestSeqNum). AODV protocols are based on DSDV and DSR algorithms. The protocols are works on routing tables and initiate route discovery process. In discovery method, the packet broadcast through source and this packet is Route Request (RREQ) packet and the neighbor nodes onward the packet to their neighbors until active route founds and maximum number of hops achieved. The RREQ packets do not know about active route. AODV performance and efficiency is best due to three metrics: packet delivery ratio, routing overhead and path optimality.
- *Dynamic Source Routing*- Dynamic Source Routing (DSR) is a similar to AODV. It forms route on demand and depend on source routing instead of table. DSR is beacon-less and does not require periodic hello packets. The approaches of DSR is flooding the route request packets dynamically in network and its request carries the route-traversed packet in its header. The complete ordered list of nodes are allowing packet for routing and avoiding the need for up-to-date routing and loop free information to the intermediate nodes. the addition of this technique, the route is in the header of each data packet, and other nodes are forwarding and cache the routing for future use.
- *Temporally Ordered Routing Algorithm (TORA)* - Based on link reversal algorithm that creates a Direct Acyclic Graph (DAG) towards the destination where source node acts as a root of the tree. TORA works on limited control message propagation in the highly dynamic Ad-hoc networks. In TORA the node clearly initiates a query when it need to send the data to destination. TORA tasks are maintenance of route , Creation of route from source to destination and erasure of the route when the route is no longer valid and for these tasks the three types of messages use QRY for creating, maintaining and CLR for erasing the route. TORA is to minimize the communication overhead when topology is change. It is efficient for dynamic Ad-hoc networks and better than DSR based on performance in the networks.

### *C. Hybrid*

This type of protocol reduce the control overhead of proactive routing protocol and decrease the initial route discovery delay in reactive routing protocols. Example: - ZRP, HARP.

- *Zone Routing Protocol (ZRP)*-The Zone Routing Protocol (ZRP) decreases the delay and high overhead for discovering the route. The protocol divides into zone distinct and overlapping zones as a group of nodes and the nodes are in zone radius. The zones are creates on the base of hop distance and chosen through

topological distribution of nodes. At the edge of zone, the nodes are called peripheral nodes. The functions of peripheral nodes are route discovery outside zone and for this a reactive approach is used Inter-zone routing protocol (IERP). A proactive routing protocol is used in inside the zone that is called Intra-zone Routing Protocol (IARP).

- *HARP:* It divides entire network into non-overlapping zones .It aims to establish a stable route from a source to a destination to improve delay. It applies route discovery between zones to limit flooding in the network, and choose best route based on the stability criteria. In HARP routing is performed on two levels: intra-zone and inter-zone, depending on the position of destination. It uses proactive and reactive protocols in intrazone and inter-zone routing respectively. It is not applicable in high mobility adhoc networks.

### 3. Position based routing protocol

In this protocol each node knows its geographic position and its neighbor node's geographic position determining services like GPS. It does not maintain any routing table or exchange any link state information with neighbor nodes. Position based routing protocol are communicate to know Vehicles position information and Global positioning service (GPS) [5]. It doesn't need to create and maintain global routes. This protocol has more stable in high mobility environment. More fitting for network distributed nodes. Lowest overhead and more scalable. It has a Deadlock problem in location server. Position services may fail in tunnel or obstacles (missing satellite signal).Example Protocols: GPSR, GPCR, CAR, GSR, A-STAR, STBR.

- *Greedy Perimeter Stateless Routing (GPSR)*-select a node which is closest to the final destination using beacon. It uses the greedy forwarding algorithm. Each node periodically broadcasts a beacon message to all its neighbors that containing its id and position. If any node does not receives any beacon message from a neighbor for a specific period of time, then GPSR router assumes that the neighbor has failed or out of range, and deletes the neighbor from its table. It takes greedy forwarding decisions using information about immediate neighbors in the network. For any node if greedy forwarding is impossible then it uses perimeter of the region strategy to find the next forwarding hop. In a city scenario greedy forwarding is often restricted because direct communications between nodes may not exist due to obstacles such as buildings and trees. Converting network topology into planarized graph when greedy forwarding is not possible will degrade the performance of routing.
- *Greedy Perimeter Coordinator Routing (GPCR)* - Based on pre selected path which has been designed to deal with the challenges of city scenario. It uses greedy algorithms to forward packet No global or external information like static map does not require in GPCR. It does not require any global or external information. For representing the planar graph it uses the underlying roads though it is based on the GPSR. It has no as usual a planarization problem like unidirectional links, planar sub-graphs & so on. the problems are it depends on junction nodes and there has a problem in the Junction detection approach in which first approach fails on curve road & second approach fails on a sparse road.
- *Connectivity-Aware Routing (CAR)*- Uses AODV for path discovery and uses dissemination mode. For city and/or highway environment Connectivity-Aware Routing (CAR) is designed. It uses guard concept to maintain the path. It does not require digital map. CAR ensures to find the shortest connected path because CAR has higher packet delivery ratio than GPSR .It has unnecessary nodes can be selected as an anchor. It cannot adjust with different sub-path when traffic environment changes.
- *Geographic Source Routing (GSR)* - Greedy forwarding along with a pre-selected shortest path. It is calculated using dijkstra algorithm.
- *Anchor-based Street Traffic Aware Routing (A-STAR)* - It is specially design for city scenarios for inter vehicle communication system. Ensures high connectivity in packet delivery by using vehicular traffic city bus information for an end-to-end connection. In low traffic density, A-STAR ensures for finding an end-to-end connection. By comparing with the greedy approach of GSR & the perimeter mode of GPSR. A-STAR uses a new local recovery strategy which is more suitable for city environment. Path selection of A-STAR ensures high connectivity though its packet delivery ratio is lower than GSR & GPSR.
- *Street Topology Based Routing (STBR)*-Idea of elucidate a given street map as a planar graph which has three valid states. It traverses least spanning multiple junctions for long distance unicast communication. STBR is not appropriate for mixed scenarios because it would try to send junction beacons along a highway. In STBR complexity increases because of some special cases like transferring the two-hop neighbor table to the new master when the old master leaves the junction.

### 4. Broadcast based routing protocol

Broadcast routing protocol is a flooding based protocol. It is used for sharing information in vanet among vehicles such as when accident or an event occurs. This protocol send packet to all neighbor nodes in the network which cause exponential increase in message transmission. This protocol is more reliable

in data transmission and it has less packet loss. Patel et al., 2012 and Jayakumar et al., 2013 analyze that broad cast based protocol have consumes bandwidth and less network throughput. It has more packet delay and packet collisions [6]-[7]. Example Protocols: BROAD-COMM, EAEP, DV-CAST, SRB, PBSM, PGB, UMB.

*BROAD-COMM*-used for highway network. The out performs better for simple highway structure which contains smaller number of nodes.

- *Edge-Aware Epidemic Protocol (EAEP)* - It is reliable, bandwidth efficient information dissemination based highly dynamic VANET protocol. It reduces control packet overhead by eliminating exchange of additional hello packets for message transfer between different clusters of vehicles and eases cluster maintenance. Each vehicle piggybacks its own geographical position to broadcast messages to eliminate beacon messages. Upon receiving a new rebroadcast message, EAEP uses number of transmission from front nodes and back nodes in a given period of time to calculate the probability for making decision whether nodes will rebroadcast the message or not. But EAEP does not address the intermittent connectivity issue. Specifically, a node does not know whether it has missed any messages to its new neighbors or its neighbors have missed some messages. EAEP overcomes the simple flooding problem but it incurs high delay of data dissemination.
- *Distributed Vehicular Broadcast Protocol (DV-CAST)* - It uses local topology information by using the periodic hello messages for broadcasting the information. Each vehicle uses a flag variable to check whether the packet is redundant or not. This protocol divides the vehicles into three types depending on the local connectivity as well connected, sparsely connected, totally disconnected neighborhood.. The pros are using flag variable check whether the packet is redundant or not. This protocol causes high control overhead and delay in end to end data transfer.
- *Secure Ring Broadcasting (SRB)*-it classifies nodes into three groups based on receiving power as follows. a) Inner nodes b) Outer nodes c) Secure Ring nodes. It minimizes number of retransmission messages to get more stable routes. It restricts rebroadcasting to only secure ring nodes to minimize number of retransmissions.
- *Parameter less Broadcasting in Static to highly Mobile Wireless ad hoc (PBSM)*-It does not need to know neighbor information. To eliminate redundant broadcasting it uses Connected Dominating Sets (CDS) and neighbor elimination concepts. PBSM uses store and forward method to deliver the message in whole network which employs high end to end delay this is not acceptable in safety application for VANET.
- *Urban Multihop Broadcast (UMB)*-To solve collision and hidden node problems during message distribution .It performs well in higher packet loads and vehicle traffic density.

## 5. Multicast based routing protocol

Multicast based routing protocol is communicated with more than two vehicles. This protocol has two types.

- Geocast based
- Cluster based

### *A. Geocast routing protocol*

It is a location based multicast routing protocol which Is used to send a message to all vehicles in a pre-defined geographical region. The selected area for transmission is called Zone of Relevance (ZOR). This type of protocol sending packets from source to a group of destinations using geographic addresses. Efficient routing by sending one copy to multiple nodes is a concept. The work by Mane et al., 2014 analyzes that Geocast based protocols have minimum network consumption and consumes bandwidth. More overhead in dividing network nodes into group [8].Example Protocols: IVG, ROVER, DTSG.

*Inter Vehicle Geocast (IVG)*-Disseminating safety messages to vehicles on highways.

- *Robust Vehicular Routing (ROVER)*- It is a reliable geographical multicast protocol where only control packets are broadcasted in the network and the data packets are unicasted. The objective of the protocol is to send a message to all other vehicles within a specified Zone of Relevance (ZOR).The ZOR is defined as a rectangle specified by its corner coordinates. A message is defined by the triplet [A, M, Z]. It indicates specified application, message and identity of a zone respectively. When a vehicle receives a message, it accepts the message if it is within the ZOR. It also defines a Zone of Forwarding (ZOF) which includes the source and the ZOR. All vehicles in the ZOF are used in the routing process. It uses a reactive route discovery process within a ZOR. This protocol creates lot of redundant messages in the network which leads to congestion and high delay in data transfer.
- *Dynamic Time-Stable Geocast Routing (DTSG)*-This Protocol is to work with sparse density networks. It dynamically adjusts the protocol depending on network density and the vehicles speed for better performance. It defines two phases: pre-stable and stable period. Pre-stable phase helps the message to be disseminated within the region, and stable- period intermediate node uses store and forward method for a predefined time within the region.

Table 1
Comparison of routing protocols in VANET

| Parameters / Protocols | Forwarding Strategy | Routing maintenance | Scenario | Recovery Strategy | Digital map | Control packet Overhead | No of transmission |
|---|---|---|---|---|---|---|---|
| FSR | Multihop | Proactive | Urban | MultiHop | No | High | Less |
| OLSR | Multihop | Proactive | Urban | MultiHop | No | High | Less |
| TBRPF | Multihop | Proactive | Urban | MultiHop | No | High | Less |
| AODV | Multihop | Reactive | Urban | Store and Forward | No | Low | Less |
| ZRPDSR | Multihop | Reactive | Urban | Store and Forward | No | Low | Less |
| TORA | Multihop | Reactive | Urban | Store and Forward | No | Low | Less |
| ZRP | Multihop | Hybrid | Urban | Multihop | No | Moderate | Less |
| HARP | Multihop | Hybrid | Urban | Multihop | No | Moderate | Less |
| GPSR | Greedy Forwarding | Reactive | Urban | Store and forward | Yes | Moderate | Less |
| VGPR | Greedy Forwarding | Reactive | Urban | Store and forward | Yes | Moderate | Less |
| GPCR | Greedy Forwarding | Reactive | Urban | Store and forward | Yes | Moderate | Less |
| ROVER | Multihop | Reactive | Urban | Flooding | No | High | High |
| DTSG | Multihop | Reactive | Urban | Flooding | No | Moderate | High |
| HCB | Multihop | Reactive | Urban | Store and Forward | Yes | Moderate | High |
| CBLR | Multihop | Reactive | Urban | Flooding | Yes | Less | High |
| CBR | Multihop | Reactive | Urban | Store and forward | Yes | Moderate | High |
| CBDRP | Multihop | Reactive | Urban | Store and Forward | Yes | Moderate | High |

- *Cluster Based Routing Protocol*- A group of nodes identifies themselves to be a part of cluster and each cluster has its one cluster head. It is responsible for the intra cluster and inter cluster Communication. In intra cluster the communication between nodes will be through direct link. In inter cluster the communication will be through cluster head. It divides the network to clusters and each cluster has a cluster head to manage communication inside the cluster [9]. Jadhav et al., 2014 conclude that cluster based protocol has a minimum packet delivery delay and easy to implement and Transparent to the changeable addresses (no requirement to receiver's address) [10].Example Protocols: HCB, CBDR, CBLR, CBR, LORA-CBF.
- *Hierarchical Cluster Based Routing Protocol (HCB)*- HCB is a high Mobility adhoc network. It is a novel based Hierarchical Cluster routing protocol designed for highly mobility adhoc networks. HCB is two-layer communication architecture. In layer-1 mostly nodes have single radio interface and they communicate with each other via multi-hop path. Among these nodes some also have another interface with long radio communication range called super nodes which exist both on layer-1and 2. Super nodes are able to communicate with each other via the base station in layer-2. During the cluster formation, each node will attach to the nearest cluster header and super nodes will become cluster headers in layer-1. In HCB, intra-cluster routing is performed independently to each cluster.
- *Cluster Based Directional Routing (CBDR)*-Cluster Based Directional Routing Protocol is moving in same direction. Source node send packet to cluster head and its responsibility to transfer the packet. It is Reliable and it is a rapid data transfer. When packet forwarding, the direction and velocity are noted in this protocol.
- *Cluster Based Location Routing (CBLR)*-A routing table is maintained by each cluster head which contains the addresses and locations of the cluster network. Cluster head track information about neighboring clusters by using Cluster Neighbor Table. It is suitable for high mobility network.
- *Cluster Based Routing (CBR)*-Based on position and cluster, the geographic area is divided into a number of square grids. A vehicle in a grid is elect as cluster head. It broadcast a LEAD message to its neighbor and when its leave the grid it broadcast LEAVE message containing its grid position.
- *Location Routing Algorithm with Cluster-Based Flooding (LORA-CBF)*-It is same as greedy routing. Cluster-head responsible for maintain information between nodes. When two clusters is connected by a node then it is called gateway. Cluster head and gateway send location request (LREQ) packets when destination node does not exist.

## 6. Comparison of existing protocols

An Existing Routing protocols are analyzed and compared from the work done by Agarwal et al., 2013, Samara et al., 2010,Jasutkar et al.,2013,Kharat et al., 2011, Dorle et al., 2012 and Mahgoub et al.,2013 as shown below in Table 1.

## 7. Conclusion

Some of the characteristics of VANETs which differentiates from other mobile ad hoc network are frequent changing topology and high mobility, no power constraint, geographical positioning availability, hard delay constraints and modeling

mobility and corresponding prediction. In this paper we are deriving some of the protocols that are transferring information.

## References

[1] Adil Mudasir Malla Ravi Kant Sahu, "A Review on Vehicle to Vehicle Communication Protocols in VANETs", International Journal of Advanced Research in Computer Science and Software Engineering 3(2), February - 2013, pp. 409-414.

[2] Bijan Paul, Mohammed J. Islam "Routing Protocols for Vehicle to Vehicle Communication", IOSR Journal of Computer Engineering (IOSRJCE) ISSN: 2278-0661, ISBN: 2278-8727 Volume 7, Issue 5 (Nov-Dec. 2012), pp. 01-09.

[3] Sakshi Makhija, Shubham Malik, "Performance Evaluation of Topology Based Routing Protocols in VANET", IPASJ International Journal of Computer Science (IIJCS), Volume 1, Issue 2, July 2013.

[4] Namita Chandel, Vishal Gupta, "Comparative Analysis of AODV, DSR and DSDV Routing Protocols for VANET City Scenario", International Journal on Recent and Innovation Trends in Computing and Communication (IJRITCC), ISSN: 2321-8169 June 2014, Volume: 2 Issue: 6, 380 – 1384.

[5] Sharnjeet Kaur, Dr. Gurpreet Singh Josan, "Performance Evaluation of Topology Based Routing Protocols in Vanet", International Journal of Engineering Research and Applications (IJERA), Vol. 2, Issue 5, September- October 2012, pp.1646-1655.

[6] D. M. Nikumbh, A.D.Bhoi, "A Survey of Positioned Based Routing Protocol in VANET", International Journal of Modern Engineering Research, Vol.3, Issue.2, March-April. 2013 pp. 1015-1018.

[7] Viral J. Patel, Anuradha P. Gharge, "A Review on Routing Overhead in Broadcast Based Protocol on VANET", International Journal of Engineering and Innovative Technology, Volume 2, Issue 5, November 2012.

[8] Jothi K. R, Ebenezer Jeyakumar A, "A Survey on Broadcasting Protocols in VANETs" International Journal of Innovative Technology and Exploring Engineering, Volume-3, Issue-6, November 2013.

[9] Pooja Mane, Reshma Zambare, Priyanka Kanake, Priyanka Harale, Uma Nagaraj, "Performance Analysis of Geocast Routing Protocol In Vehicular Ad-Hoc Network", International Journal of Advance Foundation and Research in Science and Engineering, Volume 1, Issue 1, June 2014.

[10] M. Hari Prasad, P. Kowsalya "Performance Enhancement of VANETs UsingCluster Based Routing" International Journal of Innovative Research in Science, Engineering and Technology, Vol. 3, Issue 5, May 2014.

[11] Nisha V. Jadhav, "Review of VANET Mobility Models with New Cluster Based Routing Protocol", International Journal of Computer Science and Information Technologies, Vol. 5 (3), 2014, pp. 3107 – 3111.

[12] Udit Agarwal, Monika Saxena, "Comparative and Behavioral Study of Various Routing Protocols in VANET", International Journal of Advanced Research in Computer Science and Software Engineering, October - 2013, pp. 769-773.

[13] Ghassan Samara, Wafaa A.H. Al-Salihy, R. Sures, "Security Analysis of Vehicular Ad Hoc Networks(VANET)", Second International Conference on Network Applications, Protocols and Services,2010.

[14] Vimmi A. Gajbhiye, Ratnaprabha W. Jasutkar, "A Review and Comparative Study of Routing Protocols for VANET", Journal Of Research, Vol. 2, Issue 1, February 2013, Page 11.

[15] Uma Nagaraj, M. U. Kharat, Poonam Dhamal, "Study of Various Routing Protocols in VANET", International Journal of Computer Science & Technology, Vol. 2, Issue 4, Oct.-Dec. 2011.

[16] Pooja Duddalwar, Atul Deshmukh and S. S. Dorle, " A Comparative Study of Routing Protocol in Vehicular Ad Hoc Network", International Journal of Emerging Technology and Advanced Engineering, Volume 2, Issue 3, March 2012.

[17] Marwa Altayeb and Imad Mahgoub, "A Survey of Vehicular Ad hoc Networks Routing Protocols" International Journal of Innovation and Applied Studies, Innovative Space of Scientific Research Journals, Vol. 3 No. 3 July 2013, pp. 829-84.