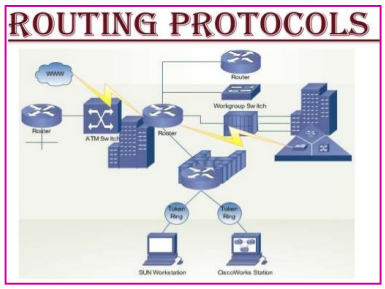
ISSN: 2347-2723 IMPACT FACTOR : 3.3754(UIF) VOLUME - 5 | ISSUE - 1 | AUGUST - 2017

REVIEW OF LITERATURE

A STUDY OF DISTINCT KINDS OF ROUTING PROTOCOLS IN VANET, THEIR ADVANTAGES AND DISADVANTAGES



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ABSTRACT:

Vehicular ad-hoc network (VANET) is a dynamic network with the application of driverless vehicles. VANET uses distinct routing protocols to obtain the route from origin to the goal. These protocols must be adaptive such that route may changes according to the environmental surroundings like traffic etc. AODV (Ad-hoc on-demand distance vector routing) is found to be systematic routing protocol for any dynamic network but this protocol doesn't supply the actual position of the nodes. The GPSR (Geographic parameter stateless routing) is a well-organized protocol which also supplies the actual position of the nodes. Geographic parameter stateless routing protocol moves to local maxima mode when no any nearby node is found for the transmission. But the performance of the GPSR gets degraded in the local maxima mode. In this work, firstly distinct routing protocols have been compared by using distinct parameters.

KEYWORDS : *VANET- Vehicular ad-hoc network, AODV-Ad hoc On-demand Distance Vector, NS2-Network Simulator Version 2, VANET- Vehicular Ad Hoc Network, MANET- Mobile Ad Hoc Network, V2V -Vehicle to-vehicle.*

• INTRODUCTION

An Ad-hoc network is an accumulation of remote portable nodes powerfully framing a brief system without the utilization of existing system or brought together organization. In such a system, every node is supposed to the part of a host and in addition a switch, sending bundles for distinct nodes in the system that may not be inside the immediate compass of remote transmission scope of each other. "Specially appointed" is really a Latin expression that signifies "for this reason".

It is routinely used to portray orderings that are produced on – the – fly for a particular reason. In a PC systems administration, an impromptu system is characterized as "... a self-ruling ordering of switches (and related hosts) related by remote connections—the union of whose frame a self-assertive diagram. The switches are allowed to move haphazardly and sort out itself discretionarily; consequently, the system's remote topology may change rapidly and eccentrically. Such a system may work in a standalone form, or might be associated with the bigger Internet working as a half and half altered/specially appointed system."
The zones of use reach from school classes over surely understood administrations like visit rooms to internet shopping, yet they are additionally utilized for potential emergency administration application in

common and military situations, for example, reactions to storm ,seismic tremor, torrent, terrorism and war zone situations where the entire correspondence foundation is demolished and reestablishing correspondence rapidly is pivotal . Besides, it is not in any case important to have a human collaboration element: specially appointed systems can likewise be utilized to interface together research PCs or moving vehicles that trade data "out and about", unbeknownst to the driver.

A remote specially appointed system is a decentralized sort of remote system. The system is Ad-hoc in light of the fact that it doesn't depend on a prior base, for example, routers[1]. Rather, every hub shows an interest in steering by sending information for distinct hubs, thus the ascertainment of which hubs forward information is made powerfully in view of the system accessibility. It is Client-Client or Peer-Peer model.

They can be further delegated per their application:

- Mobile Ad-hoc Networks (MANET)
- Wireless Mesh Networks (WMN)
- Wireless Sensor Networks (WSN)

• CLASSIFICATION OF ROUTING PROTOCOLS

A steering convention choose the method for trading data in two correspondence substances; it permits the procedure in set up a course, taking choice for sending, and taking remedial activities in keeping up the course or recuperating from directing disappointment [1]. In Vehicular impromptu system, the steering conventions are ordered into five principle classifications. Which are as follows: Topology based, Position based, Cluster based, Geo-cast and broadcast steering conventions. These conventions are separated on the premise of utilization where they are most appropriate [4].

2.1 Topology Based Routing Protocols

These sorts of steering conventions use joins data that exists in the system to perform bundle sending. They are again classified as: Proactive (table-driven), Reactive (on-demand) and Hybrid Protocols.

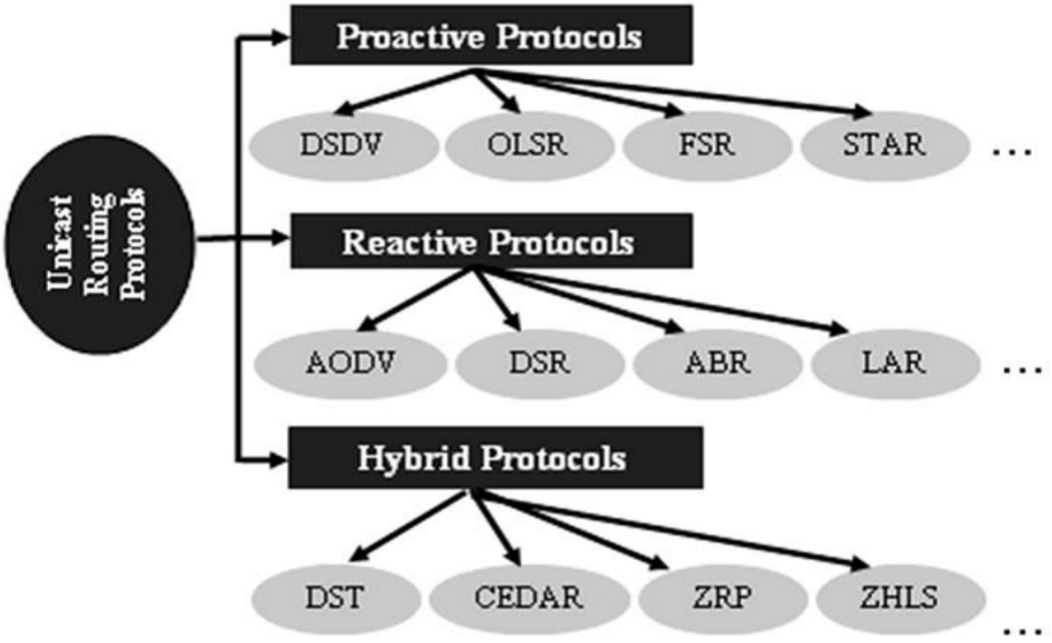


Figure 2.1: Routing protocols

2.1.1 Proactive steering conventions

The proactive steering implies that the directing data, as next sending jump is kept up out of sight regardless of correspondence solicitations. Proactive routing protocol based on shortest path algorithm. The distinct sorts of proactive steering conventions are: FSR, DSDV, OLSR, CGSR, WRP, and TBRPF.

Advantages:

-There is no requirement of route discovery.
-Low latency is required for real time applications.

Disadvantages:

- The unutilized routes hold a crucial part of the available bandwidth.

2.1.1.1 Fisheye state routing (FSR)

Uma Nagaraj, Dr. M. U. Kharat, Poonam Dhamal "Investigation of Various Routing Protocols in VANET" ISSN: 0976-8491(Online) | ISSN: 2229-4333(Print) IJCST Vol. 2, Issue 4, Oct-Dec.2011 [4].FSR means fisheye state directing. In FSR, every node keeps up a topology table (TT) which contains the most recent data got from its neighboring and opportune trades it with closely neighbors' node. For substantial size systems to minimize the extent of message, the FSR apply the distinctive trade time frame for distinct sections in steering tables. The passages in directing table or a given destination are upgraded rather with the neighbors having low recurrence as the separation to destination increments.

Advantages:

-FSR overcomes significantly the used bandwidth as it exchanges partial routing update information with only neighbors.
- FSR overcomes routing overhead.
-In FSR, Changing in the routing table will not take place even if there is any link failure because it doesn't trigger any control message for link failure.

Disadvantages:

-FSR gives very poor performance in small ad- hoc networks.
-FSR has poor realization about distant nodes.
-On increasing in network size, the storage convolution and the processing load of routing table also increases.
-FSR has improper information for route establishing.

2.1.1.2 Destination-Sequenced Distance-Vector Routing (DSDV)

Uma Nagaraj, Dr. M. U. Kharat, Poonam Dhamal "Investigation of Various Routing Protocols in VANET" ISSN: 0976-8491(Online) | ISSN: 2229-4333(Print) IJCST Vol. 2, Issue 4, Oct-Dec.2011 [4]. DSDV is a table-driven steering approach for portable specially appointed systems which depends on the Bellman-Ford calculation. It was proposed by C. Perkins and P.Bhagwat in 1994. It takes out course circling, builds union speed, and lessens control message overhead. In DSDV, every hub keeps up a next-jump table, which it trades with its neighbors.

Advantages:

- DSDV supply loop free routing protocol.
- No route discovery is required in DSDV because route is already stored in background.

Disadvantages:
-In VANET, network topology change very rapidly. So, number of incremental packets will also increase. This will increases the load in the network.

2.1.1.3 Optimized Link State Routing Protocol (OLSR)

It is an improvement of an unadulterated connection state convention for versatile impromptu systems. OLSR convention is a proactive connection state directing convention which diminishes the control overhead by decreasing the quantity of communicates as contrasted and unadulterated visually impaired "flooding" systems. The essential idea of OLSR is the utilization of multipoint transfers (MPRS). Topology disclosure is utilized to decide the topology of the entire system and to build the directing tables [82-83].

Advantages:
- OLSR reduces the routing load linked with table driven routing in addition to reducing the number of broadcast done
- In broadcast framework, OLSR reduce the number of retransmission of packets.
- OLSR takes very few time in setup the connection and reduced control overhead.

Disadvantages:
-In OLSR, very high amount of bandwidth and CPU power is required to compute the optimal path.

2.1.1.4 Cluster head Gateway Switch Routing (CGSR)

The CGSR convention contrasts from the past convention in the sort of tending to and arrange association plan utilized. Or maybe having a level system, CGSR is an on the entire multi-bounce portable remote system with a few guidelines steering procedure. It express that a bunch head is controlling a gathering of impromptu hubs, a model for isolating the code, channel access, steering and data transfer capacity allotted can be accomplished.

Advantages:
- CGSR gives partial coordination between nodes by electing cluster heads, so better bandwidth utilization is possible.
- It is easy to implement priority scheduling scheme with token scheduling and gateway code scheduling

Disadvantages:
- Increase in path length and instability in the system at high mobility when the rate of change of cluster heads is high.
- Higher power consumption at cluster head nodes can lead to multiple path breaks.

2.1.1.5 Wireless Routing Protocol (WRP)

The WRP portrayed in [3] is a table-based convention with the objective of keeping up directing data among all hubs in the system. Every hub in the system is in charge of keeping up four tables: (a) separation table, (b) steering table,(c) join cost table, and (d) message retransmission list (MRL)table.

Advantages:
-WRP has faster convergence and involves fewer updates.

Disadvantages:
-WRP requires higher memory and high processing power from nodes in wireless ad-hoc network.
-WRP is not suitable for highly dynamic and for very large ad- hoc wireless network.

2.1.1.6 Topology Dissemination Based on Reverse-Path Forwarding (TBRPF)

It is a connection state directing convention intended for impromptu systems. Each hub makes a source tree which contains ways of every single reachable hub into topology table. Hubs are occasionally upgraded with just the contrasts between the past state and current system state utilizing HELLO messages. Along these lines, directing messages are little size, can in this way be sent all the more as often as possible to neighbors.

Advantages:

- In TBRPF, Routing messages are smaller and can therefore be sent more frequently to neighbors

Disadvantages:

- In TBRPF, there is an overhead of source tree construction.

2.1.2 Reactive/Ad hoc based steering

Responsive steering decides courses on an as-required premise: when a hub has a parcel to transmit, it questions the system for a directing or in receptive directing; the courses opened just when hub speak with each other. Receptive steering having a course disclosure stage in which the inquiry parcels are overflowed into the system for the way look and when courses discovered then this stage gets to be finished. Reactive steering is called on demand steering as it starts route finding when a node requires communicating with other node thus it overcome network traffic. The various types of receptive directing conventions are AODV, TORA, PGB, DSR, JARR and so on.

Advantages

-In Ad-hoc routing, To update routing table not require periodic flooding the network. Flooding requires only when it is demanded.
-Beaconless so it saves the bandwidth.

Disadvantages

- Latency is high in finding route.
-Excessive flooding of the network causes disruption of nodes communication.

2.1.2.1 Ad Hoc on Demand Distance Vector (AODV)

AODV directing was proposed by Perkins in 1999. In AODV directing in the wake of accepting of a communicate course ask for (RREQ), the hubs record the location of the hub sending which sends the question/demand in their steering table. It has the ability of unicast & multicast routing. The methodology of recording its past jump is called in reverse learning. Subsequent to coming to at the destination hub, a course answer (RREP) is sent by destination hub through the regressive figuring out how to the source hub. AODV manufactures courses utilizing a course ask for/course answer question cycle. A hub accepting the RREQ may send a course answer (RREP) on the off chance that it is either the destination or on the off chance that it has a course to the destination with comparing grouping number more prominent than or equivalent to that contained in the RREQ. On the off chance that a connection break happens while the course is dynamic; the hub upstream of the break spreads a course mistake (RERR) message to the source hub to educate it of the now inaccessible destination(s). In the wake of getting the RERR, if the source hub still yearnings the course, it can reinitiate course disclosure [78-79].

Advantages:

-AODV has an up-to-date path to the destination because it uses destination sequence number.
-AODV overcomes too much memory requirements and the route redundancy.
-AODV gives response if the link is failure in the network.

-AODV can be applied to big scale ad-hoc network.

Disadvantages:

-In AODV, more time is required for connection setup & initial communication to establish a route compared to other protocols.
-If intermediate nodes contain old entries, it can lead inconsistency in the route.
-For a single reply packet if there has multiple route reply packets this will causes to heavy control overhead.
-Because of periodic beaconing AODV consume extra bandwidth.

2.1.2.2 Preferred Group Broadcasting (PGB)

PGB was proposed by Naumov in 2006. Favored Group Broadcasting is a telecom system that points is to decrease AODV course disclosure communicate overhead and to give course dependability which is particularly imperative in VANET where rapid moving vehicles are utilized as remote hosts. In the wake of accepting communicate signals, a recipient then figures out which are in the favored gathering and which one in the communicate bunch.

Advantages:

-PGB reduce numbers of RREQ broadcasting

Disadvantages:

- PGB is not reliable broadcasting protocol.

2.1.2.3 Dynamic Source Routing (DSR)

DSR was proposed by Johnson in 1996. DSR utilizes origion directing as a part of which the origion demonstrates the succession of middle hubs on the steering way in an information bundle. In DSR, the inquiry parcel duplicates the IDs of the halfway hubs in its header that it has navigated. At that point destination recovers the entire way from the inquiry parcel and uses it to advise to the origion. DSR is a responsive convention i.e. it doesn't utilize intermittent notices. There are two critical stages in working of DSR: Route Discovery and Route Maintenance. In DSR, as the course is a piece of the parcel itself, steering circles, either fleeting or extensive, can't be framed as they can be rapidly distinguished and wiped out [80-81].Node D does not forward RREQ, because node D is the intended large of route discovery.

Advantages:

- DSR has fewer Beacons.
-To obtain route between the nodes, DSR has small overload on the network. It uses caching which overcomes the load on the network for future route discovery.
- In DSR periodical update is not required.

Disadvantages:

-If there are too many nodes in the network, the route information within the header will lead to byte overhead.
-There is unnecessary flooding burden the network.
-In high mobility pattern DSR performs worse.
-DSR is unable to repair broken links locally.

2.1.2.4 Temporally Ordered Routing Algorithm (TORA)

TORA was proposed by Park in 2007. TORA steering contains a group of connection inversion directing calculations where a coordinated non-cyclic chart (DAG) at the destination is drawn which depends

on the tallness of the tree established at the source. The coordinated non-cyclic diagram coordinates the stream of bundles and guarantees its achieving capacity to all hubs.

Advantages:

-TORA creates DAG (Direct acyclic graph) when necessary.
-TORA reduce network load because all intermediate nodes don't need to rebroadcast the message.
-TORA perform well in dense network.

2.1.3 Hybrid Protocols

The cross breed conventions are exhibited to minimize the control overhead of proactive directing conventions and lessened the underlying course disclosure delay in responsive steering conventions.

2.1.3.1 Zone routing protocol (ZRP)

In ZRP the system is partitioned into covering zones. The zone is characterized as an accumulation of hubs which are in a zone sweep. The measure of a zone is computed by a span of length α where α is the quantity of jumps to the border of the zone. In ZRP, a proactive steering convention (IARP) is utilized as a part of intra-zone correspondence and an inward zone receptive directing convention (IARP) is utilized as a part of intra-zone correspondence. Source hub can sends information specifically to the destination hub just when both hubs are in same directing zone generally IERP responsively begin a course disclosure.

Advantages*:*

-ZRP reduces the control load compared to the root request flooding mechanism employed in on requirement approaches and the periodic flooding of routing information packets in table driven approaches.

Disadvantages*:*

-ZRP is not suitable for highly mobile network, where network topology changes very fast.
-In ZRP, size of zone is predefined and fixed. Zone size cannot change after implementation.
-zone size is problem in this.

2.1.3.2 Hybrid Ad Hoc Routing Protocol (HARP)

It isolates complete system into non-covering zones. The point of HARP is to setup an altered course from an origin hub to a goal hub to increase delay. It course revelation is connected between zones to minimize flooding in the system, and pick best course in view of the solidness criteria. The Distributed Dynamic Routing (DDR) algorithm is exploited by HARP to provide underlying supports. In DDR, nodes periodically exchange topology messages with their neighbors. A forest is constructed from the network topology by DDR in a distributed way. Each tree of the forest forms a zone. Therefore, the network is divided into a set of non-overlapping dynamic zones. A mobile node keeps routing information for all other nodes in the same zone.

Advantages:

-HARP establishes and maintains the most stable path from origin to the goal in order to increase the efficiency of data transmission in mobile ad hoc networks.
-HARP uses a hierarchical topology provided by DDR in order to reduce the control message overhead.
-HARP overcomes both bandwidth usage, and energy utilization of non-forwarding nodes.
- HARP keep away from the extra delay caused by path failure during data transmission.

Disadvantages:

- HARP is not alluring in high versatility specially appointed systems.

2.2 Position Based Routing Protocols

Position based directing comprises of a class of steering calculation. In position based routing protocols, every node knows its own and its neighbor node geographic position by position determining services or devices like GPS etc. It doesn't keep any routing table or exchange any link state information with its nearby nodes. Information provided by GPS system is used for taking routing decision. There are various types of position based greedy V2V protocols such as GPSR, PRB-DV, GRANT, GPCR, GpsrJ, CAR, GSR, A-STAR, STBR , GyTAR, LOUVER, DIR, ROMSGP, AMAR, EBGR, B-MFR, ABR, MORA, VGPR, MIBR, DTSG, TO-GO, CBF etc.

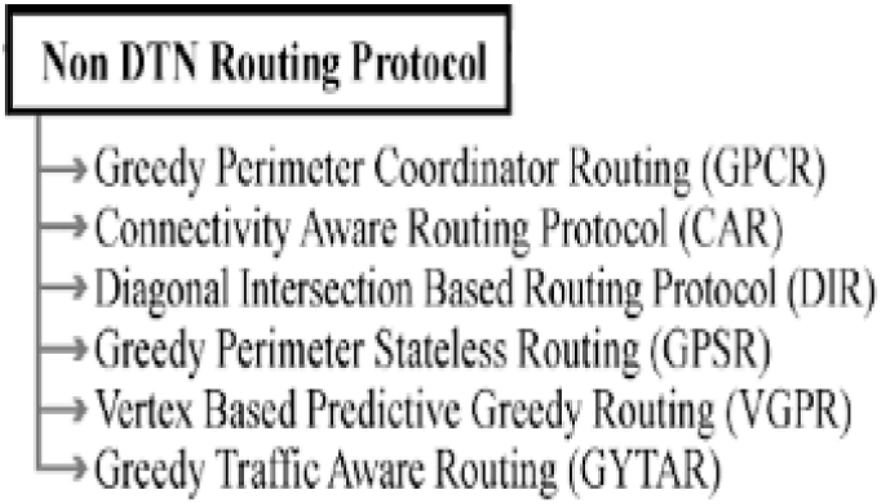
Advantages:

-In position based routing protocols, Route discovery & management is not required.
- Position based routing protocols provides scalability.
- Position based routing protocols are suitable for high node mobility pattern.

Disadvantages:

- Position based routing protocols requires position determining services.
-GPS device doesn't work in tunnel because satellite signal is absent there.

2.2.1 Non DTN



2.2.1.1 Greedy Perimeter Stateless Routing (GPSR)

Greedy Perimeter Stateless Routing (GPSR) was found by Karp in 2000 .In GPSR; a hub advances a parcel to a closest neighbor which is geologically nearer to the destination hub. This method of sending is named voracious mode. At the point when a bundle achieves a neighborhood greatest then recuperation mode is utilized to forward a parcel to a hub that is nearer to the destination rather than the hub where the parcel experienced the nearby most extreme.

Advantages:

-In GPSR, to forward the packet, a node needs to remember only one hop neighbor location.
-In GPSR, Forwarding packet decisions are made dynamically.

Disadvantages:

-For high mobility characteristics of node, stale information of neighbors' position is often contained in the sending nodes' neighbor table.

-Though the destination node is moving its information in the packet header of intermediate node is never updated.

2.2.1.2 Position-Based Routing with Distance Vector Recovery (PRB-DV)

PBR-DV utilizes AODV style for recuperation when bundles fall into a nearby most extreme. The hub at the neighborhood most extreme would communicate a solicitation parcel which contains the node position and destination's area. In the wake of getting a solicitation parcel, a node first check the node position to confirm that it is nearer to the goal than the node at the neighborhood greatest.

Advantages:

- No comparison is done with any other routing protocol. So, uncertain about packet delivery ratio & overhead (load).

Disadvantages:

-In PRB-DV, for non-greedy part excessive flooding is required.

2.2.1.3 Greedy Routing with Abstract Neighbor Table (GRANT)

GRANT was proposed by Schnaufer in 2008. It utilizes expanded ravenous steering where each hub knows its x jump neighborhood. This gives each hub a far located vision of the best course to take and to keep away from neighborhood greatest.

Advantages:

-In city scenario with obstacles this extended greedy routing approach works well than as usual greedy approach.

Disadvantages:

- VANET has a high mobility characteristics but the performance evaluation of GRANT is done on static traces.

-The overhead of beacon and possible inaccuracy in packet delivery are not measured.

2.2.1.4 Greedy Perimeter Coordinator Routing (GPCR)

Kevin C. Lee," Survey of Routing Protocols in Vehicular Ad Hoc Networks" [5]. GPCR depends on the way that city road constructed a characteristic organizer chart. GPCR does not require any external static road map for its operation. GPCR have two parts. To begin with, first is a Restricted Greedy sending technique and second is a repair procedure for steering calculation. A GPCR complies with a goal based ravenous sending idea; it courses messages to hubs at intersection. Since GPCR not utilize any outside static road outline hubs at intersection are hard to discover.

Advantages:

-GPCR does not require any global or external information.

-For representing the planar graph GPCR uses the underlying roads though it is based on the GPSR.

-GPCR has no as usual a planarization problem like unidirectional links, planar sub-graphs & so on.

Disadvantages:

-GPCR depends on junction nodes.

-In GPCR, There has a problem in the Junction detection approach in which first approach fails on curve road & second approach fails on a sparse road.

2.2.1.5 GpsrJ+

Kevin C. Lee, "Study of Routing Protocols in Vehicular Ad Hoc Networks" [5]. It evacuates the undesirable stoppage at an intersection while maintaining the productive planarity of topological maps. It utilizes two-jump neighbor beaconing to foresee which street fragment its neighboring intersection hub will take. On the off chance that the expectation shows that its neighboring intersection will forward the parcel onto a street with an alternate bearing, it advances to the intersection hub; else, it sidesteps the intersection and advances the bundle to its uttermost neighboring hub.

Advantages:

-The packet delivery ratio of GPCR increases which is managed by GPSRJ+.
-The number of hops in the recovery mode of GPSR is reduced by 200%.
- A high-cost planarization strategy is not required in GPSRJ+.

Disadvantages:

- GpsrJ+ protocol is not appropriate for the delay sensitive applications.
- GpsrJ+ did not apply on realistic city map that are not necessarily grids.
- GpsrJ+ has used simple line trajectory but realistic roads follow a more complex trajectory.

2.2.1.6 Connectivity Aware Routing Protocols (CAR)

Naumov, V, "Auto in VANET", May, 2007 [6]. Network Aware Routing (CAR) was proposed by Naumov et al. in 2007. Taking after their work on to minimize communicate from AODV course disclosure and Advanced Greedy Forwarding (AGF) to represent hub versatility.

Advantages:

-No digital map is required in Connectivity Aware Routing Protocols.
- Connectivity Aware Routing Protocols has no local maximum problem.
- CAR ensures to find the shortest connected path because CAR has higher packet delivery ratio than GPSR.

Disadvantages:

-Unnecessary nodes can be selected as an anchor.
- Connectivity Aware Routing Protocols cannot adjust with distinct sub-path when traffic environment changes.

2.2.1.7 Geographic Source Routing (GSR)

Lochert, C, "A directing technique for vehicular impromptu systems in city situations", June, 2003 [7]. GSR was before utilized as a part of MANET. At that point it was altered to utilize it in VANET situation by joining into it insatiable sending of messages toward the destination. On the off chance that at any jump there are no hubs toward destination then GPSR utilizes a recuperation technique known as edge mode.

Advantages:

- In Geographic Source Routing, Packet delivery ratio of GSR is better than AODV & DSR.
- Geographic Source Routing is scalable than AODV & DSR.

Disadvantages:

- Geographic Source Routing protocol neglects the situation like sparse network where there are not enough nodes for forwarding packets.

- Geographic Source Routing shows higher routing overhead than GyTAR because of using hello messages as control messages.

2.2.1.8 Anchor-Based Street and Traffic Aware Routing (A-STAR)

Seet, B.- C., "A-STAR: A Mobile Ad Hoc Routing Strategy for Metropolis Vehicular Communications" 1980 [8]. A-STAR was proposed by Seet in 2004. A-STAR is prone to GSR; in GSR bundles are steered through stay purposes of the overlay. In any case, A-STAR is activity mindful: the movement out and about figures out if the grapple purposes of the street will be considered in the most limited way.

Advantages:

- A-STAR ensures for finding an end-to-end connection in low traffic density.
-By comparing with the greedy approach of GSR & the perimeter mode of GPSR. A-STAR uses a new local recovery strategy which is more worthy for city environment.
-Path selection of A-STAR ensures high connectivity though its packet delivery ratio is lower than GSR & GPSR.

Disadvantages:

-Packet delivery ratio of A-STAR is lower than GSR & GPSR.
-To find a path from origin to goal it uses static information based on city bus routes which causes connectivity problem on some portion of streets.

2.2.1.9 Street Topology Based Routing (STBR)

Forderer, D (2005), "Road Topology Based Routing" Master's proposal, May 2005 [9]. STBR was proposed by Forderer in 2005. STBR went more distant than A-STAR by figuring the street availability at intersection hubs. Among every one of the hubs at an intersection one hub is chosen as an expert hub that is in charge of checking connections to the following intersections are up or down.

Advantages:

- STBR traverses least spanning multiple junctions for long distance unicast communication.

Disadvantages:

-STBR is not relevant for mixed scheme 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.

2.2.1.10 Greedy Traffic Aware directing convention (GyTAR)

Moez Jerbi, "GyTAR", September 2006[10]. GyTAR was proposed by Jerbi in 2007.GyTAR is a methodology prone to the methodologies specified above , in that parcels are sent covetously toward the following intersection which will then decide the best intersection to forward next.

Advantages:

- For high mobility topology changes rapidly and often occurring network fragmentation which is proficiently control by GyTAR.
-Performance shows that throughput, delay and routing load are better than GSR.

Disadvantages:

- GyTAR depends on roadside units because it assumed that the number of cars in the road will be given from road side units.
-Gytar cannot avoid void.

2.2.1.11 Landmark Overlays for Urban Vehicular Routing Environments (Louver)

K. Lee, Gerla, Louver, 2008[11]. Lee et al. (2008) has compressed geographic avaricious overlay directing into two camps. The main camp is geo-receptive overlay directing where the following overlaid hub is resolved taking into account their neighboring hubs' separation to the destination (STBR) or a blend of it and movement thickness (GyTAR). The second camp is geo-proactive overlay directing where the succession of overlaid hubs is resolved from the earlier (GSR and A-STAR).

Advantages:

- Louver avoids void and backtracking because of using estimation of Peer-to-peer density.
- Packet delivery ratio of Louver is higher than GPCR & GPSR.
- Louver ensures an obstacle free geographic routing.

Disadvantages:

-Because of delivering unsuccessful packets in Louver, it has a little higher hop count than GPCR.
- Louver is less scalable.

2.2.1.12 Vertex-Based Predictive Greedy Routing (VGPR)

Raj K. Shrestha, "Vertex based multi-bounce vehicle to base steering for vehicular specially appointed systems", 2010[12]. It is a multi-bounce vehicle-to-foundation steering convention for urban area. It ascertains a course of action of legitimate intersections from a source hub to settled framework and afterward, transmit message to the altered base through the ordering of intersections. It utilizes position, speed and heading of vehicles for ascertaining both ordering of legitimate intersections and covetous sending.

Advantages:

- VGPR having less control overhead
- VGPR reduces packet retransmissions
- VGPR increases reliability of packet delivery ratio
- VGPR minimizes end to end delay

Disadvantages:

- Validity measurement of junctions may become tedious some time in VGPR.

2.2.1.13 Mobile Infrastructure Based VANET Routing (MIBR)

Jie Luo, "A Mobile Infrastructure Based VANET Routing Protocol in the Urban Environment", 2010[13]. This steering use transports as a key component for selecting the course and information exchange process. While indicating the convention status of transmission for every street portion and diverse transmission capacities of various vehicles are additionally broke down. It assesses each street section thickness utilizing transport line data. MIBR is an area based receptive directing convention. Source hub utilizes GPS framework for getting the destination data. Every transport has two distinctive remote interfaces and others have single interface.

Advantages:

- MIBR has less complexity.
- Throughput in MIBR is high as comparison to others.
- MIBR has easy Deployment.

Disadvantages:

- Leads to inaccuracy of statistical data impacts on network performance.

2.2.1.14 Dynamic Time-Stable Geocast Routing (DTSG)

Hamidreza Rahbar, Kshira sagar Naik, Amiya Nayak, "DTSG: Dynamic Time-Stable Geocast Routing in Vehicular Ad Hoc Networks", 2001[14]. The primary point of this convention is to work even with inadequate thickness systems. It powerfully modifies the convention relying upon system thickness and the vehicles speed for better execution. It characterizes two stages: pre-steady and stable period. Pre-stable stage helps the message to be spread inside the district, and stable-period middle hub utilizes store and forward strategy for a predefined time inside the locale.

Advantages:

- DTSG adjusts network density dynamically and the vehicles speed for better performance.

Disadvantages:

- No. of retransmission high in DTSG.

2.2.1.15 Topology-help Geo-Opportunistic Routing (TO-GO)

Lee, K.C.; Lee, U.; Gerla, M. (2009), "TO-GO: Topology help geo-astute steering in urban vehicular matrices", 2009[15]. TO-GO is geographic directing convention which enhances parcel conveyance in insatiable and recuperation sending that can sidestep the intersection region by utilizing two bounce beaconing. No shrouded terminal happens on the grounds that all hubs can hear each other. In TO-GO routing protocol, packet is marked for an anchor node, determined by the Next-hop Prediction Algorithm (NPA), and then broadcasted.

Advantages:

-No hidden terminal occurs in TO-GO routing because all nodes can hear one another.
-From simulation result TO-GO, GPCR, GpsrJ+ have similar packet delivery ratio.
- Low S/N ratio is taken care of.

Disadvantages:

-Simulation result shows that End-to-End latency in TO-GO is higher than GPCR, GPSR, GpsrJ+.

2.2.1.16 Contention-Based Forwarding (CBF)

FuBler, H, "Dispute Based Forwarding for Street Scenarios", 2004[16]. CBF is a geographic directing convention that does not make utilization of signals. In CBF if there has an information parcel to send, the sending hub will communicate the bundle to every single direct neighbor and these neighbors will discover among themselves the one that will forward the parcel. Disposal of guide message spares transmission capacity.

Advantages:

- CBF saves bandwidth by eliminating beacon message.
- By ignoring inaccurate neighbor tables CBF reduces the probability of packet collision & inefficient routing.
- CBF protocol provides a lower packet forwarding delay when node mobility is high.

Disadvantages:

- In high way destination is always straight forward so local maximum never occurs as a result CBF works well but in city environment local maximum frequently occurs because source and destination may lie on distinct path.

2.2.2 DTN Position Based Routing Protocols

2.2.2.1 Vehicle-Assisted Data Delivery (VADD)

J. Zhao , VADD, "Vehicle-Assisted Data Delivery in Vehicular Ad Hoc Networks", 2006[17]. VADD was proposed by Zhao et al. in 2006.VADD is a vehicular directing methodology went for enhancing steering in separated vehicular systems by convey and-forward in light of the utilization of unsurprising vehicle portability. A vehicle settles on a choice at an intersection and chooses the following sending way with the littlest bundle conveyance delay. A way is essentially an extended street from a crossing point.

Advantages:

-Comparing with GPSR (with buffer), epidemic routing and DSR, VADD performs high delivery ratio.
- VADD is suitable for multi-hop data delivery.

Disadvantages:

- Due to change of topology & traffic density VADD causes large delay.

2.2.2.2 Geographical Opportunistic Routing (GeOpps)

I. Leontiadis, GeOpps, "Astute Geographical Routing for Vehicular Networks", 2007[18]. GeOpps (2007) exploits the proposed courses of vehicles' route framework to choose vehicles that are liable to draw nearer to the last destination of a parcel. It computes the most limited separation from bundle's destination to the closest point (NP) of vehicles' way, and assessments the landing of time of a parcel to destination.

Advantages:

-By comparing with the Location-Based Greedy routing and MoVe routing algorithm GeOpps has high delivery ratio.
-To find a vehicle which is driving towards near the goal GeOpps require few encounters.
- The delivery ratio of GeOpps rely on the mobility patterns & the road topology but not dependent on high density of vehicles.

Disadvantages:

-Privacy is an issue because navigation information is disclosed to the network.

2.2.3 Hybrid Position Based Protocols

2.2.3.1 Geo-DTN+Nav

P.C. Cheng, "Geodtn nav. Geographic dtn steering with pilot forecast for urban vehicular environments",2010[19]. Geo-DTN+Nav were proposed by Cheng et al. in 2008. This convention is a Combination of non-DTN and DTN approach that incorporates a covetous mode, a border mode, and a DTN mode. It can changes from non-DTN mode to DTN mode by evaluating the availability of the system in light of the quantity of jumps a bundle has voyage as such, neighbor's conveyance quality, and neighbor's bearing regarding the destination. The dormancy increments and the declines parcel conveyance proportion in a circumstance, for example, inadequate system where GeoDTN+Nav trys to fall-back to DTN mode once more.

Advantages:

-GeoDTN+Nav can switch from Non-DTN to DTN mode.
-GeoDTN+Nav can recognize partition in the network.

Disadvantages:

-The latency increases & the decreases packet delivery ratio in a situation such as sparse network where GeoDTN+Nav trys to fall-back to DTN mode again.

-The result in a partitioned network shows that RandDTN achieves slightly better PDR and lower latency than GeoDTN+Nav.

2.3 Cluster Based Routing Protocols

Bunch based directing is favored in groups. A gathering of hubs distinguishes themselves to be a piece of group and a hub is assigned as bunch head will communicate the bundle to bunch. Great versatility can be accomplished for vast systems however organize deferrals and overhead are brought about when shaping groups in exceptionally portable VANET. The distinct Clusters based directing conventions are COIN, LORA-CBF, TIBCRPH, and CBDRP.

Advantages:

- Cluster Based Routing Protocols need not discover route so routing load is low.

Disadvantages:

- Cluster Based Routing Protocols doesn't consider velocity and direction which is important parameter for VANET.

2.3.1 Cluster-Based Directional Routing Protocol (CBDRP)

Tao Song," A Cluster-Based Directional Routing Protocol in VANET"[20]. It moves the vehicles into groups and (vehicles which are moving in same heading make a bunch). The source hub sends the message to its group header and after that it sends the message to header which is in the same bearing with the destination. At long last the destination header sends the message to the destination. The bunch header choice and repairing is prone to the CBR however it assesses speed and position of a vehicle.

Advantages:

- CBDRP traverses least spanning multiple junctions for long distance uni-cast communication.
- Every node store information about its neighbors node.
- Cluster head maintains information about its members and its neighboring cluster heads

-Link stability problem solve in VANET.

-In CBDRP data transfer is reliable and rapid.

Disadvantages:

- CBDRP is not appropriate for mixed scenarios because it would try to send junction beacons along a highway.

-In CBDRP 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.

-In CBDRP control packet overhead is average.

-Number of retransmission is high is CBDRP.

2.3.2 Traffic Infrastructure Based Cluster Routing Protocol with Handoff (TIBCRPH)

Tiecheng Wang Gang Wang, "TIBCRPH Traffic Infrastructure Based Cluster Routing Protocol with Handoff in VANET"[21]. Hub's high portability prompts continuous softened courses up VANET, utilizing bunch can accomplish proficient transmission of messages. The leaving movement bases to group the system will help the transmission of information bundles. Because of the attributes of radio-correspondence, the cover between groups will happen definitely, so as to guarantee the administration nature of hubs' interchanges, it make utilization of the handoff thought of cell systems and propose another convention which is exceptional for VANET, the proposed plan is named Traffic Infrastructure Based Cluster Routing Protocol with Handoff.

Advantages:

-Alternate paths and disjoint paths are immediately available allowing faster recovery from failure and topology changes.

2.3.3 Location Routing Algorithm with Cluster-Based Flooding (LORA-CBF)

R.A.Santos, "Execution assessment of steering conventions in vehicular specially appointed systems" 2005[22]. In LORA_CBF, every hub can turn into the bunch head, portal or group part. For every bunch, there is one group head. The hub which interfaces two groups are called portal. The bunch head keeps up data about its individuals and doors. The parcel sending is same the avaricious steering. Just bunch head and portals can convey the area demand (LREQ) bundles when the area of the destination is not accessible and the period of the Location Reply (LREP) messages. The proposed LORA-CBF indicates profoundly heterogeneous execution results.

Advantages:

- Location Routing Algorithm with Cluster-Based Flooding provides same packet forwarding as greedy routing

Disadvantages:

- Location Routing Algorithm with Cluster-Based Flooding gives eterogeneous performance results.

2.3.4 Clustering for Open IVC Network (COIN)

J. Blum, "Portability administration in IVC systems," 2003[23]. Bunch head determination in COIN relies on vehicular movement and driver shock as opposed to ID or relative versatility as in ordinary grouping techniques. IVC likewise obliges the oscillatory way of between vehicle separations. In a perfect world, the relative portability between a group head and a part hub ought to be low, so they stay in radio contact for whatever length of time that conceivable.

Advantages:

- Clustering for Open IVC Network does not use ID for selection of cluster head.
- In COIN protocol, it depends at vehicle driver intension and the dynamicity of vehicle node

Disadvantages:

- COIN is not suitable for high mobility environment

2.3.5 Hierarchical Cluster Based Routing (HCB)

Yang Xia,"Hierarchical Cluster Based Routing for Highly Mobile Heterogeneous MANET", 2007[24]. It is a novel based Hierarchical Cluster directing convention intended for exceptionally portability impromptu systems. HCB is two-layer correspondence engineering. In layer-1 as rule hubs have single radio interface and they speak with each other by means of multi-bounce way.

Advantages:

- In HCB, Intra-cluster routing is performed independently in each cluster.
-Cluster heads exchange membership information periodically to enable inter-cluster routing.

Disadvantages:

-Number of retransmission is high in HCB because of high packet loss.

2.3.6 Cluster Based Location Routing (CBLR)

R.A.Santos, "Utilizing the group based area directing calculation for trading data on a motorway", Sept 2002[25]. This calculation expects all vehicles can assemble their positions through GPS. The calculation

partitions the system into various bunches. Every bunch has a bunch head and a gathering of individuals inside the transmission scope of the group head. The group head and individuals are shaped as take after: another vehicle transmits a Hello Message.

Advantages:
- CBLR is suitable for high mobility network.
-In CBLR digital map is used
- CBLR has low control packet overhead.

Disadvantages:
- CBLR has high number of retransmission.

2.3.7 Cluster Based Routing (CBR)

Yuyi Luo, "A New Cluster Based Routing Protocol for VANET",2010[26]. CBR (Cluster Based Routing) Protocol Just as its name infers, it's a steering convention which in light of position and groups. In this convention, the geographic territory is partitioned into approximately foursquare lattices. Just if there is a vehicle in a network will a vehicle be chosen to the group header, and the information parcel is directed by bunch header over a few matrices one by one.

Advantages:
- CBR need not to discover route every time so routing overhead is less.

Disadvantages:
-This protocol doesn't consider velocity and direction which is important parameter for VANET.

2.4 Geo Cast Routing Protocols

In Geo Cast Routing, every hub can decide its area and also destination area. With this data, a message can be sent to the destination without knowing the system topology or the disclosure of the course[37].Geo cast steering is fundamentally an area based multicast directing. Its objective is to send the parcel from source hub to every other hub inside a chose area Zone of Relevance (ZOR). The distinct Geo cast steering conventions are IVG, DG-CASTOR and DRG

2.4.1 Inter-Vehicle Geocast (IVG)

A. Bachir, "A Multicast Protocol", in Ad hoc Networks Inter-Vehicle Geocast April 2003[27]. IVG is proposed by Bachir et al. for scattering wellbeing messages to vehicles on interstates. The Inter-Vehicle Geocast Protocol (IVG) is developed for relaying emergency messages in a highway accident situation. A broken down vehicle sends out an alarm to approaching vehicles. The packets are only relayed by nodes inside a risk area. The convention utilizes a clock based component for message sending and occasional communicates are utilized to conquer system fracture. To overcome network fragmentation periodic broadcasting is used.

Advantages:
- Besides, IVG protocol reduces the hops of delivering message by using the deferring time

Disadvantages:
- No time-to-live limit to prevent infinite broadcasting.

2.4.2 Distributed Robust Geocast (DRG)

H. P. Joshi, "Appropriated Robust Geocast Multicast Routing for Inter-Vehicle Communication"[54]. DRG steering convention is proposed by Joshi et al. The DRG convention enhances the unwavering quality of message sending by characterizing the zone of sending (ZOF) which encompasses the district of interest. Vehicles in the ZOF area forward the message to distinct vehicles in the ROI.

Advantages:

- The DRG protocol has objective to enable forwarding of messages as fast and reliable fashion that minimizes the network load.

Disadvantages:

- No state information saved in DRG protcol.

2.4.3 Robust Vehicular Routing (ROVER)

M. Kihl, "Solid Geographical Multicast Routing in Vehicular Adhoc Networks", 2007[28]. It is a solid land multi-cast convention in which just control parcels are communicated in the system while the information bundles are unicasted. The point of this convention is to exchange a message to all vehicles inside a predefined Zone of Relevance (ZOR). The ZOR is characterized as a rectangle indicated by its corner arranges. A message is characterized by the triplet [A, M, Z] it demonstrates determined application, message and personality of a zone separately.

Advantages:

- ROVER is a reliable geographical multicast protocol where only control packets are broadcasted and the data packets are unicasted in the network.

Disadvantages:

- Because of redundant message, ROVER has high delay in data transfer.
-Control Packet overhead and no. of retransmission high

2.4.4 Dynamic Time-Stable Geocast Routing (DTSG)

Hamidreza Rahbar, "DTSG, Dynamic Time-Stable Geocast Routing in Vehicular Ad Hoc Networks", 2001[29]. The primary point of this convention is to work even with inadequate thickness systems. It powerfully conforms the convention relying upon system thickness and the vehicles speed for better execution. It has two stages: pre-steady and stable period. Pre-stable stage helps the message to be spread inside the area, and stable-period middle of the road hub utilizes store and forward strategy for a predefined time inside the locale.

Advantages:

- DTSG dynamically adjusts network density and the vehicles speed for better performance.

Disadvantages:

- No. of retransmission high in DTSG.

2.5 Broadcast Based Routing Protocols

Communicate directing is for the most part utilized as a part of VANET for sharing, movement signal, climate data, and crisis, street situations among vehicles and passed on commercials and declarations. The distinct Broadcast directing conventions are BROADCOMM, UMB, V-TRADE, and DV-CAST.

2.5.1 BROADCOMM

M. Durresi, "Crisis communicate convention for entomb vehicle interchanges," 2005[30]. BROADCOMM depends on hierarchal structure for expressway system. In BRAODCOMM directing the expressway is apportioned into virtual cells which move like vehicles. The hubs in the thruway are sorted out into two level of framework as the primary Level incorporates every one of the hubs in a cell and the second level is spoken to by cell reflectors (which are couple of hubs found shut to geological focus of cell) Cell reflected carries on like a bunch head for certain interim of time and handles the crisis messages which are originating from individuals from the cell or adjacent neighbor.

Advantages:

- BROADCOMM performs better outperforms for simple highway structure which contains fewer number of nodes.

Disadvantages:

-In BROADCOMM position information fully depends on formation of cells.

2.5.2 Urban Multi-jump Broadcast Protocol (UMB)

G. Korkmaz, "Urban multi-jump communicate convention for bury vehicle correspondence frameworks"[31]. UMB is intended to beat the obstruction, parcel impact and shrouded hub issues amid message circulation in multi jump communicate. In UMB the sender hub tries to choose the uttermost hub in the communicate bearing for sending and recognizing the bundle with no earlier topology data. UMB convention performs with much accomplishment at higher bundle burdens and vehicle movement densities.

Advantages:

- UMB reduces Packet collision and hidden node problems.
-Successfully performs at higher packet loads and vehicle traffic densities environment.

Disadvantages:

-Waste Bandwidth

2.5.3 Vector Based Tracing Detection (V-TRADE)

M. Entirety, "GPS-based message broadcasting for Inter vehicle", 2000[32]. It is a GPS based message broadcasting conventions. The essential thought is like uni-cast directing conventions Zone Routing Protocol (ZRP). V-TRADE arranges the neighbors into various sending bunch relying on position and development data. For every gathering just somewhat set of vehicles is chosen for rebroadcasting the message.

Advantages:

- GPS based message broadcasting protocol.
-Bandwidth utilization is enhanced.

Disadvantages:

- Routing overheads occur for selecting the next forwarding node.

2.5.4 Distributed Vehicular Broadcast Protocol (DV-CAST)

O. K. Tonguz, "Broadcasting in VANET", 2007[33]. By the assistance of occasional hi messages, it utilizes nearby topology data for transmitting the data. Each vehicle contains a banner variable for looking at that the bundle is valuable or not. This convention partitions the vehicles into three classifications relying upon the nearby availability also associated, feeble associated and completely disengaged neighborhood.

Advantages:
-By using flag variable check whether the packet is redundant or not.
- DV-CAST is suitable for both of dense and sparse traffic scenarios and reduces the broadcasting overhead.

Disadvantages:
-Control overhead is high in DV-CAST.
-End to end data transfer delay is high.

2.5.5 Edge-Aware Epidemic Protocol (EAEP)

M. Nekovee, "Solid and effective data dispersal in discontinuously associated vehicular specially appointed systems", 2007[34]. It is solid; transfer speed effective data transmission based very dynamic VANET convention. It minimizes control parcel overhead by expelling trade of additional welcome bundles for message exchange between various groups of vehicles and facilitates bunch upkeep. Every vehicle changes its own position to communicate messages to evacuate reference point messages. Subsequent to accepting another message, EAEP utilizes number of transmitted message from front hubs and back hubs in a given day and age to ascertain the likelihood for taking choice whether hubs will retransmit the message or not.

Advantages:
- EAEP reduce control packet overhead by eliminating hello packets.
- EAEP overcome simple flooding problem.

Disadvantages:
- EAEP does not address the intermittent connectivity issue.
- EAEP has high delay of data transmission.

2.5.6 Secure Ring Broadcasting (SRB)

Rainer Baumann, "Vehicular Ad hoc Networks", Master's Thesis in Computer Science, ETH Zurich 2004[35]. It is to diminish number of retransmission messages and to get much steady courses. It isolate hubs into three gatherings relies on upon their getting power as Inner Nodes (near sending hub), Outer Nodes (far from sending hub), Secure Ring Nodes (attractive separation from sending hub). It limits rebroadcast to just secure ring hubs to decrease number of retransmissions.

Advantages:
-To get more stable routes SRB minimize number of retransmission messages.

Disadvantages:
-Control packet overhead is high in SRB.

2.5.7 Parameter less Broadcasting in Static to Highly Mobile Wireless Ad Hoc (PBSB)

Adnan Afsar Khan, "Parameter less communicating in static to exceedingly portable remote impromptu, sensor and actuator systems", August 1999[36]. It is a versatile telecom convention that does not oblige hubs to think about position and development of their hubs and itself. It utilizes associated overwhelming sets (CDS) and neighbor disposal ideas to wipe out excess telecom. It utilizes two-bounce neighbor data acquired by occasional guides to build CDS. Every vehicle has two orderings of neighboring vehicles that are R and NR. R list containing neighbors that effectively got and NR have which did not get the parcel.

Advantages:

-Parameter less protocol does not consider vehicle position, direction and velocity.

- It uses connected dominating sets (CDS) and neighbor elimination concepts to eliminate redundant broadcasting

Disadvantages:

-in PBSB control packet overhead is high.

- PBSB uses store and forward method to deliver the message in entire network which gives high end to end delay. This is not acceptable in safety application for VANET

3. CONCLUSION

Routing is an vital component of communication protocols in vehicular ad hoc networks. The design of the protocols are driven by specific goals and requirements based on respective assumptions about the network properties or application area. VANETs have grown out of the need to support the growing number of wireless products that can now be used in vehicles. These products include remote keyless entry devices, personal digital assistants, laptops and mobile telephones. As mobile wireless devices and networks become increasingly important, the demand for Vehicle-to-Vehicle (V2V) and V2R or Vehicle-to-Infrastructure (V2I) Communication will continue to grow.

As in VANET, nodes (vehicles) have high mobility and moves with high speed. Proactive based routing is not suitable for it. Proactive based routing protocols may fail in VANET due to consumption of more bandwidth and large table information. AODV is a reactive routing protocol, which operates on hop-by-hop pattern. The Ad hoc On-Demand Distance Vector (AODV) [2] algorithm enables dynamic, self-starting, multi-hop routing between participating mobile nodes wishing to establish and maintain an ad hoc network. AODV allows mobile nodes to obtain routes rapidly for new destinations, and does not require nodes to maintain routes to destinations that are not in active communication.

We have discussed several routing protocols, among them AODV is best suited to improve the performance. As AOMDV is an extended protocol of AODV. AOMDV is performed better in case of high level density.

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