An Ordinary & Innovative Packet Routing Schemes in VANET

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Abstract – *VANETs are start-of-the-art technology integrating ad hoc network, wireless LAN (WLAN) and cellular technology to achieve intelligent Inter-Vehicle Communications (IVC) and Roadside-to-Vehicle Communications (RVC). However this network share some common characteristics of Mobile Ad Hoc Network (MANET) for organization of the nodes but due to unique characteristics as high mobility and unreliable channel conditions, it face many challenging research issues, such as data dissemination, data sharing, and security issues. Many researchers has given their contribution in this area of research and lot of are going on to reduce complications of VANETs network. This paper presents some of the current research solution with brief introduction of routing and routing protocols of VANETs.*

Key Words: VANETs, MANETs, Routing, Routing Protocols, Ad-hoc Network.

1. INTRODUCTION

From past decades, with the use of embryonic wireless network VANETs have turned into an important research area. It is a cooperative engagement of a collection of mobile devices, herein referred to as nodes, without the required intervention of any centralized access point or existing infrastructure. Each node is equipped with a wireless transmitter and a receiver. The topology of such networks is likely highly dynamic because each node can freely move without existence of pre-installed base stations. VANETs are start-of-the-art technology integrating ad hoc network, wireless LAN (WLAN) and cellular technology to achieve intelligent Inter-Vehicle Communications (IVC) and Roadside-to-Vehicle Communications (RVC). Schematic representation of a Vehicular Adhoc Network present in fig.1
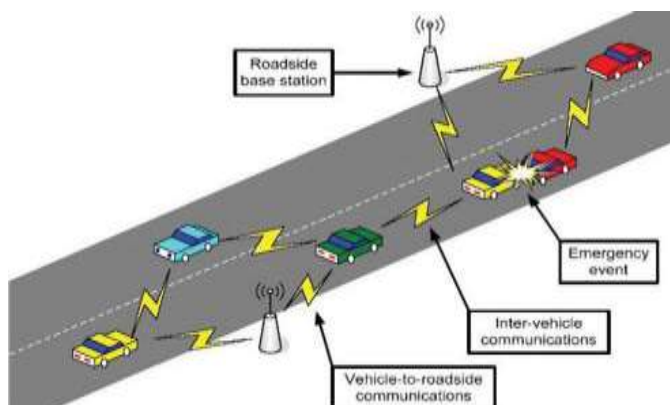

Fig- 1 Vehicular Ad hoc Network

VANETs share some common characteristics of general Mobile Ad Hoc Network for organization of the nodes but due to high nodes mobility and unreliable channel conditions, this class of network have face many challenging research issues, such as data dissemination, data sharing, and security issues.

However, much of researchers have given their contribution to reduce such issues and currently all major vehicles manufacture companies and industries have taken these issues into their accounts for enhancing the performance of VANETs [1-6]. This paper investigates the state of art work of VANETs related to routing protocols and their associated issues. Further this paper is organized as follows: Section 2 describes the basic concepts of routing along-with taxonomy of ordinary routing schemes in VANETs. Section 3 covers the basic issues of conventional routing schemes. Section 4 illustrates innovative routing scheme of VANETs. Section 5 exemplifies the current challenging issues of this network and finally section 6 present the conclusion and future scope in the field of VANETs which may be helpful for upcoming researcher to understand and set their vision.

2. ORDINARY STEERING SCHEMES OF VANETs

At all times routing schemes plays a key role in performance of any communication network. Typically routing is the act of moving information from a source to a destination in an internetwork which involves two activities: determining optimal routing paths and transferring the packets through an internetwork. The transferring of packets through an internetwork is called as packet switching which is straight forward and the process of path determination find out and maintains routing tables; contain total route information for the packet. The information of route varies from one routing algorithm to another. The routing tables are filled with entries in the routing table are ip-address prefix and the next hop. Destination/next hop associations of routing table tell the router that a particular destination can be reached optimally by sending the packet to a router representing the-address prefix specifies a set of destinations for which the routing entry is valid. Routing is mainly classified into two categories, static routing and dynamic routing [7].

Static routing refers to the routing strategy being stated manually or statically, in the router. Static routing maintains a routing table. The routing table doesn"t depend on the state of the network status, i.e. whether the destination is active or not. The major disadvantage with static routing is that if a newer router is added or removed in the network then it is the responsibility of the administrator to make the necessary changes in the routing tables. Static routing cannot

be applied efficiently for MANET due to dynamic nature of MANET.

Dynamic routing refers to the routing strategy that is being learnt by an interior or exterior routing protocol. This routing mainly depends on the state of the network i.e. the routing table is affected by the activeness of the destination. In dynamic routing, each router announces its presence by flooding the information packet in the network so that every router within the network learns about the newly added or removed router and its entries.

However, numerous investigators have categorize routing protocol of VANETs in different ways, but according to the routing strategy, network structure and on the basis of area / application where they are most suitable the routing protocols of VANETs can be broadly classified into five categories can be seen in figure 2 [8].
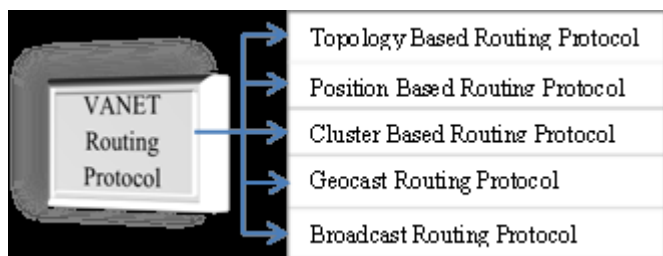

Fig-2 Routing Protocols in VANET

2.1   Topology Based Routing Protocol

The topology based routing protocols use link"s information and stores that information in table before sending data from source to destination node. Several of approaches proposed on the base of this routing approach. Topology based routing approach can be further categorized in to three groups: Proactive, Reactive & Hybrid Protocols.

Proactive routing protocols: These types of protocols are mostly based on shortest path algorithms and also known as table driven routing protocol because they store the information of all connected nodes in form of tables. Whenever any change present in network the node shared the information with their neighbors. The advantage of proactive routing protocol is that there is no route discovery since the destination route is stored in the background, but the disadvantage of this protocol is that it provides low latency for real time application.Strategies implemented in proactive algorithms are Link-state routing (OLSR), Destination Sequence Distance-vector routing (DSDV), Fisheye State Routing (FSR), Cluster head Gateway Switch Routing(CGSR), Wireless Routing Protocol (WRP), Topology Dissemination Based on Reverse Path Forwarding (TBRPF), Global State Routing (GSR), Source Tree Adaptive Routing (STAR) discussed in various papers[9-12].

Reactive Routing Protocol: The Reactive routing protocol developed to overcome the overhead of proactive routing

protocol. The Reactive routing protocol also called on-demand routing protocol because these protocol establish the route only when it is necessary and only for those nodes that are currently being used to send data packets from source to destination.

Hybrid Routing Protocols: The hybrid routing protocol combines characteristics of both reactive and proactive routing protocols and proposed to reduce the control overhead of proactive routing protocols with decreasing the initial route discovery delay in reactive routing protocols. In Hybrid vehicle communication system vehicles communicate with roadside infrastructure even when they are not in direct wireless range by using other vehicles as mobile routers.

2.2   Position Based Routing Protocols

The position based routing protocol or geographic routing protocol use nodes location information rather than link information to determine the optimal path for communication. In this type of network each node having whole information about source, destination and the intermediates nodes. With the low overhead and the dynamic connectivity of node the position based routing protocols usually perform better than topology based protocols. A position based routing protocol consists of many major components such as "beaconing", "location service and servers" and "recovery and forwarding strategies" [13].

Position based routing is broadly divided in two types: Position based greedy V2V protocols, Delay Tolerant Protocols. In the greedy forwarding strategy, an intermediate node in a route forwards packet to the farthest neighbor in the direction of the next anchor or the destination. This approach requires the intermediate node to have three important data points: the position of itself, the position of its neighbors, and the position of the destination. Typically, nodes acquired own position through GPS. Their neighbor takes positions through message exchanges, and the position of the destination node is usually found through the use of a location service. Location servers may be periodically placed external to the system, but this offers no guarantee that such a server will be within range. To alleviate this problem, quorum-based location services may be built into nodes, or fully-distributed location services may be utilized [58].

2.3   Geocast Routing Protocols

Geo cast routing is basically a location based multicast routing protocol and use to send a message to all vehicles in a pre-defined geographical region. The philosophy is that the sender node need not deliver the packet to nodes beyond the Zone of Relevance (ZOR). The scheme followed a directed flooding strategy within a defined ZOR so that it can limit the message overhead. The various Geo cast routing protocols are IVG, DG-CASTOR and DRG. However these protocols

perform well but distributing the packets to all the nodes within the geocast region with high probability with low overhead is challenging problem because a clear trade-off between the proportion of nodes in the geocast region that receive the packet and the overhead incurred by the geocast packet especially at low densities and irregular distributions.

2.4   Cluster Based Routing Protocols

This type of routing protocol is based on position and clusters. Each cluster has one cluster-head, which is responsible for intra and inter-cluster management functions. Intra-cluster nodes communicate each other using direct links, whereas inter-cluster communication is performed via cluster headers. In cluster based routing protocols the formation of clusters and the selection of the cluster-head is an important issue. In this protocol, the geographic area is divided into some foursquare grids. Only if there is a vehicle in a grid will a vehicle be elected to the cluster header, and the data packet is routed by cluster header across some grids one by one. In VANET due to high mobility dynamic cluster formation is a towering process. The various cluster based routing protocol are [14-16].

2.5   Broadcast Based Routing Protocols

This protocol most frequently used in VANET especially to sharing, traffic, weather and emergency, road conditions among vehicles and delivering advertisements and announcements. Broadcasting is used when message needs to be dispersed to the vehicle beyond the transmission range i.e. multi hops are used. Simplest of broadcast method is carried by flooding in which each node rebroadcast the message to other nodes. Broadcast sends a packet to all nodes in the network, usually using flooding techniques, ensuring the delivery of the packet but bandwidth is wasted and nodes receive duplicates. This routing technique performs better for a less number of nodes but has a higher overhead cost.

In a vehicular ad hoc network it is important that broadcast messages such as emergency warnings should be received by all vehicles in the proximity of the endangered. The existing routing protocols are effective only when the node population is small and due to the high node mobility and the movement constraints of mobile nodes the conventional topology-based routing schemes are not suitable for VANETs. There are several paper [17-19] present the issues of existing ad hoc routing protocol to apply in the environment of VANET.

3.   HITCHES WITH ORDINARY ROUTING SCHEME

Since the advent of VANETs, design and implementation of an efficient routing protocol with good performance and less overhead is one of the fundamental challenges of this network. However, various studies and researches made an endeavour to reduce conventional routing schemes issues but most of the previous work deals with the problem of finding and maintaining correct routes to the destination during mobility and changing topology. In addition, major of proposed approaches has backbone routing path that increases the overhead and consume more bandwidth and nodes power in communication, different terrains pose separate challenges to routing in high dynamic environment of MANETs. In MANETs, the Issues of accessible routing protocols can be represent in point as

- The accessible routing protocols are effective only when the node population is small.
- The proactive routing protocols will be overwhelmed by the rapid topology changes and even fail to converge during the routing information exchange stage.
- Reactive routing schemes will fail to discover a complete path due to frequent network partition.
- Most of existing routing protocols use flooding process to setup a link between the pair of nodes thus consumes high bandwidth and generates high end to end delays.
- Low scalability, where network can go from scarce to dense in a very short time.

4.   INNOVATIVE PACKET STEERING SOLUTIONS FOR VANETs

With the aim to reduce the issues of traditional routing algorithm two different groups of researchers have presents their unique ideas, name as EAODV (Enhanced AODV) and A-SAODV (Adaptive SAODV) [20, 21]. However, both the presented algorithms has improve quality of traditional AODV routing scheme but fails to maintain its functionality within high changes environment of VANETs, need some more modification to enhance throughput with occurred changes of network scenario.

To enhance the energy of network nodes a novel algorithm MECB-AODV (Modified Energy Constraint Protocol Based on AODV) has been proposed in [22]. The approach optimized the rebroadcasting procedure of existing AODV routing protocol, before rebroadcasting of a RREQ packet each and every node compare its remaining energy with a certain threshold value. A node can rebroadcast the packet to all of its neighbors only when it has the high energy value in comparison of threshold. In approach each node calculates its remaining energy to maintain the connectivity of the network as long as possible. On the other hand intermediate nodes reject the rebroadcasting of a packet when it has not sufficient energy level. The simulation results of the approach indicates that it enhance the energy level in comparison of accessible AODV routing algorithm.

In [23], authors have introduces a hop greedy routing scheme that yields a routing path with the minimum number of intermediate intersection nodes while taking connectivity into consideration. The hop greedy algorithm finds the best

possible path in terms of both hop count and connectivity. Moreover, they introduce back-bone nodes that play a key role in providing connectivity status around an intersection. Apart from this, by tracking the movement of source as well as destination, the back-bone nodes enable a packet to be forwarded in the changed direction. Simulation results signify the benefits of the proposed routing strategy in terms of high packet delivery ratio and shorter end-to-end delay. In [24], authors have propose a sequential decision vehicle selection method based on the residual file (SSRF). The method divides the process of selection into several stages and selects cooperative vehicles from the candidates; the decision sequence generated by SSRF determines the set of cooperative vehicles. Simulation and data analysis show that their proposed method is effective in terms of delivered ratio and file delivered delay.

In [25], authors have presents a connectivity-aware intersection based routing (CAIR) protocol to address existing problems by selecting an optimal route with higher probability of connectivity and lower experienced delay; then, geographical forwarding based on position prediction is used to transfer packets between any two intersections along the route. Simulation results show that the proposed protocol outperforms over the existing routing protocols in terms of data delivery ratio and average transmission delay in typical urban scenarios. In [26], authors have address the routing issues of VANETs network and proposed a cluster based routing approach, intend to escalate the routing recitation in the challenging environment of VANETs. The approach focused to find a most favorable route to the desired destination, in order to increase the connectivity and satiability, which lead then to increase the network reliability, in terms of increasing throughput, packet delivery ratio with reducing overheads and time delays.

In [27], authors have provided an overview of the main aspects of VANETs from a research perspective. This paper starts with the basic architecture of networks, then discusses three popular research issues and general research methods, and ends up with the analysis on challenges and future trends of VANETs. A novel multi-hop clustering scheme for VANETs have discussed in [28], which generates cluster heads (CHs) via neighborhood follow relationship between vehicles, is proposed. Typically, scheme is based on a reasonable assumption that a vehicle cannot certainly identify which vehicle in its multi-hop neighbors is the most suitable to be its CH, but it can easily grasp which vehicle in one-hop distance is the most stable and similar with it, and thus, they most likely belong to the same cluster. Consequently, a vehicle can choose its CH by following the most stable vehicle. The relative mobility between two vehicles combining the gains based on the followed number and the historical following information enables a vehicle to select which target to follow. Authors have performed extensive simulation experiments to validate the performance of their proposed clustering scheme. In [29] authors have illustrates the basic architecture, routing

protocols classifications, bio-inspired approaches along with applications and simulating tools for VANETs [29].

In [30], authors have proposed a unique solution to detect and control the traffic congestion by using of both (V2V) and (V2I), as a result the drivers become aware of the location of congestion as well as way to avoid getting stuck in congestion. The congestion is detected by analyzing the data obtained by vehicular communication and road side units to avoid the traffic. Our proposition system is competent of detecting and controlling traffic congestion in real-time. V2V and V2I communication network is used to receive and send the messages. The authors simulate the result by using Congestion Detection and Control Algorithm (CDCA), and show that this is one effective way to control congestion. The proposed methodology ensures reliable and timely delivery of messages to know about congestion and avoid it.

In [31] authors have introduces a flexible VANET testbed architecture that is tailored for VANET applications' needs. The implementation of this architecture is tested using standard VANET applications to evaluate its feasibility for vehicular applications. Our results confirm the suitability of the proposed testbed to meet VANET requirements. Furthermore, the effect of adding a caching entity is experimented and the results show its ability to mitigate the testbed's overhead. In [32], authors have proposed a vehicular system with three entities namely users, sink and sensor and two set of communication between user to sink and sink to sensor are needed. In short, we have proposed architecture of data traffic/movement in vehicular sensor network and authenticate the entities. In addition, we have analysed our protocol with respect to security attacks and found that it is strongly protected against security attacks. Furthermore, the proposed protocol is relatively better in terms of overhead such as computation and communication.

5. CHALLENGING FACTOR WITH VANETs ROUTING PROTOCOLS

However, a lot of works have done in area of VANETs to design an appropriate and effective routing algorithm but most of works are still simulation based which may not be suitable for real world situations. On the other hand due to the nature of dynamic network topology, routing in VANET play a vital role for the performance of the networks. There are various studies and researches in this field in attempt to propose more efficient routing protocols. However, there is not a routing protocol that can perform efficiently in every situation. Due to high mobility of network nodes and infrastructure less structure of VANET, the traditional routing protocols that are designed especially for mobile ad-hoc networks are not suited well with it. There are some features of VANET that have to keep in mind while designing routing protocols. The factor that challenge this network can be mainly point out as

Nodes frequently change their positions that make high mobility, main cause of violation of establish connection. The

routing tables must somehow reflect these changes in topology and routing algorithms have to be adapted. For example in a fixed network routing table approximately updating takes place for every 30sec. This updating frequency might be very low for VANET networks.

Due to the high node movement the path not remain constant, break and establish frequently in VANET so the packets are loss in high rate and increase delay.

Some other issues may be count as packet security, Information Dissemination and Address configuration.

6. CONCLUSION

This paper investigates a wide-range literature over conventional and innovative routing solution in area of VANETs. The findings indicate that among several of issues of VANETs efficient routing always remains as a challenging task for in this field. However, numerous routing approaches has proposed since the age of this network and continuously investigators are presents new algorithm to pick-up issues of routing in this highly dynamic and challenging environment of wireless communication network but due to unique limitation of each algorithm this field is still open with high research challenges.

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BIOGRAPHIES

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