Available Online at www.ijcsmc.com

International Journal of Computer Science and Mobile Computing

A Monthly Journal of Computer Science and Information Technology

ISSN 2320–088X

IJCSMC, Vol. 3, Issue. 9, September 2014, pg.771 – 781

RESEARCH ARTICLE

OVERVIEW OF ROUTING PROTOCOLS FOR VEHICULAR AD-HOC NETWORKS

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ABSTRACT: Vehicular Ad hoc Networks (VANETs) is the new wireless networking concept of the wireless ad hoc networks in the research community. Vehicle-to-Vehicle (V2V) communication plays a significant role in providing a high level of safety and convenience to drivers and passengers. Position based routing protocol has been identified to be suitable for VANETs because of frequently changed network topology and highly dynamic nature of vehicular nodes. Many position based routing protocols have been developed for routing messages in greedy forwarding way in VANETs. However, few of them are efficient when the network is highly dynamic. In this paper, we present an overview of existing routing protocols that are based on the position prediction of neighboring and destination nodes.

1. INTRODUCTION

Vehicular traffic accidents on the road cause losses of thousands of lives, injuries and huge material damages every year. Traffic rules violations are the main reasons of the vehicular traffic accidents. Therefore, having an efficient way to detect violations will yield reductions of traffic accidents and enable efficient traffic management system. Recent advances in telecommunications, computing and sensor technology emerged the vehicular environment as one of the hottest research areas for the communications industry. To reduce large number of vehicular traffic accidents, improve safety, and manage traffic control system with high and reliable efficiency, computer networking researchers have proposed a new wireless networking concept called Vehicular Ad hoc Network (VANET) which can increase passenger safety and provide “efficient” road and policies monitoring. In the future, VANET will provide safer and well-organized road and a large number of vehicular applications ranging from transport automation systems to entertainment and comfort based applications. VANET is one kind of vehicular communication based on wireless network technology to establish the wireless ad hoc

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network between vehicles. The goal of DSRC standard is to provide wireless communications capabilities for transportation systems within a 1000 meter range at typical highway speeds. VANET have some important characteristics such as nodes forming the networks are vehicles, restricted vehicle movements on the road, high mobility of vehicles and rapid changes in topology and time-varying vehicle density. Since the network topology in the VANETs is frequently changing, finding and maintaining routes is very challenging in VANET. To facilitate communication within a network, a routing protocol is used to find reliable and efficient routes between nodes so that message delivered between them in timely manner. Routing is responsible for selecting and maintaining routes and forwarding packets along the selected routes.

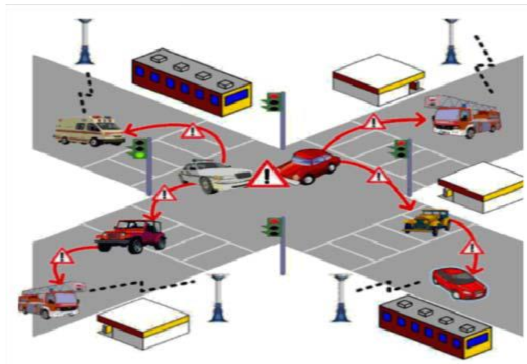

Fig. 1. Vehicular Ad hoc Networks Scenario

2. ISSUES OF ROUTING IN VANETS

Even though VANETs are capable of enabling many novel applications, the design of effective intervehicular communications remains as a challenge. The nodes in VANETs are themselves formed by vehicles with high mobility. Nodes in VANETs join and leave the network frequently, which results frequent path disruptions. The time varying vehicle density results in a rapid change in topology, which makes preserving a route a difficult task. This in turn, results in low throughput and high routing overhead. The well-known hidden terminal problem affects the performance in VANETs causing low packet reception rate. Interference from the high-rise building induces problems such as routing loops and forwarding in wrong direction, which increases delay. The issue of temporary network fragmentation and the issue of broadcast storm further complicate the design of routing protocols in VANETs. The routing protocols in VANETs should be capable of establishing the routes dynamically and maintaining the routes during the communication process. They should be capable of discovering alternate routes quickly on-the-fly in the event of losing the path.

3. VEHICLE-TO-VEHICLE (V2V) COMMUNICATION

Installing fixed infrastructure on roads incurs huge expenses, so V2V communication will be required to extend the effective range of networked vehicles. V2V communication [Readily (2010)] is the pure ad hoc communication. This type of communication is mainly used in safety applications like safety warning, traffic information, road obstacle warning, intersection collision warning etc. In V2V communication each vehicle is equipped with GPS (Global Positioning System), sensors, networking devices, digital map which has the road segment information, and computing devices. Vehicles sense its own traffic messages and communicate with its neighboring vehicles by broadcasting beacon or HELLO messages periodically.

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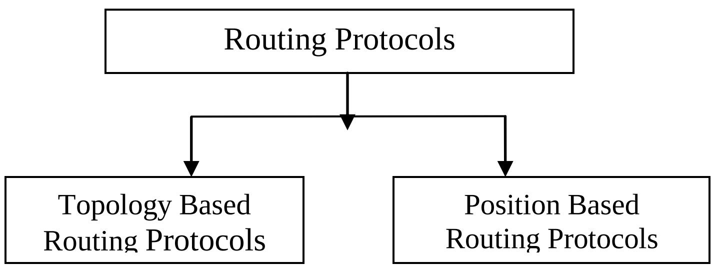
V2V communication uses both unicast and multi-cast packet forwarding techniques between source and destination vehicles. Unicast forwarding means that a vehicle can only send/ receive packet to/from its direct neighbors. While multi-cast forwarding enables the exchange of packet with remote vehicles using the intermediate vehicles as relays. In V2V communication (see fig. 2), both types of forwarding are used for different type of applications and protocols.
The IEEE 802.11p standard is used for V2V communications in highly mobile vehicular traffic environments. Installing fixed infrastructure like access points, base stations, Internet gateways, etc. on roads acquire great expense, so V2V communication will be necessary to extend the effective range of networked vehicles.

Fig. 2. VANET: V2V Communications

4. ROUTING PROTOCOLS IN V2V COMMUNICATION

4.1 Uncast Routing Protocols



Since VANETs change their network topology frequently without any prior information, routing in such dynamic networks is a challenging task. Routing protocols can be broadly classified into two categories: Topology based and Position based routing protocols.

4.1.1. Topology based routing protocols

Topology based routing protocols depend on the information about existing links in the network and use them to perform packet forwarding. The topology based routing protocols can be further subdivided into proactive, reactive, and hybrid protocols. Proactive (table-driven) routing protocols are similar to the connectionless schemes of traditional datagram networks. These protocols employ classical routing strategies such as distance-vector (e.g. DSDV) or link-state routing and any changes in the link connections are updated periodically throughout the network. Proactive protocols maintain routing information about the available paths in the network even if these paths are not currently used. The main disadvantage of these protocols is the maintenance of unused paths may occupy an important part of the available bandwidth if the network topology changes frequently. However, proactive protocols may not always be suitable for highly mobile networks such as VANETs. Reactive (on-demand) routing protocols (e.g. AODV,

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DSR) employ a lazy approach whereby mobile nodes only discover routes to destinations on-demand. These protocols maintain only the routes that are currently in use.

Reactive protocols often consume less bandwidth than proactive protocols, but the delay in determining a route can be substantially large. In reactive protocols, since routes are only maintained while in use, it is typically required to perform a route discovery process before packets can be exchanged between nodes. Therefore, this leads to a delay for the first packet to be transmitted. Another disadvantage is that, although route maintenance is limited to the routes currently in use, it may still generate a significant amount of network traffic when the network topology changes frequently. Finally, packets transmitted to the destination are likely to be lost if the route to the destination changes.

4.1.2. Position based routing protocols

Position is one of the most important data for vehicles. In VANET each vehicle wishes to know its own position as well as its neighbor vehicle's position. A routing protocol using position information in known as the position based routing protocol. Position based routing protocols need the information about the physical location of participating vehicles be available. This position can be obtained by periodically transmitted control messages or beacons to the direct neighbors. A sender can request the position of a receiver by means of a location service. Position based routing protocols are more suitable for VANETs since the vehicular nodes are known to move along established paths. Since routing tables are not used in these protocols therefore no overhead is incurred when tracing a route.

In VANETs, route is composed of several pair of vehicles (communication links) connected to each other from the source vehicle to the destination vehicle. If we know the current information of vehicles involved in the routes, we can predict their positions in the near future to predict the link between each pair of vehicles in the path. VANET is a self-organizing mobile ad hoc network in which to acquire the position information of neighboring nodes, each node periodically exchanges a list of all neighbors it can reach in one hop, using a HELLO control message or a beacon that contains its ID, location, speed, and a timestamp (see fig. 4). One of the main advantages of using position based routing protocol is that it's characteristic of not requiring maintenance of routes, which is very appropriate for highly dynamic networks such as VANETs.

4.2. CLUSTER BASED ROUTING PROTOCOLS

Clustering in vehicular ad hoc network can be defined as the virtual partitioning of the dynamic nodes into various groups. A group of nodes identify themselves to be part of a cluster. A special node, designated as cluster-head is responsible for routing, relaying of intercluster traffic, scheduling of intra-cluster traffic and channel assignment for cluster members. The cluster members do not participate in routing. An optional gateway node is also used in some of the clustering schemes, which belongs to more than one cluster, acting as a bridge between cluster heads. Inter-cluster communication is achieved either by cluster-heads or gateways, if present, whereas communication within each cluster is made through direct link. As the complexity and mobility of the network increases, the selection of cluster heads and the management of clusters becomes a challenging task.

Cluster Based Location Routing (CBLR)[61] algorithm enables a dynamic, self-starting, and multi-hop routing between nodes. It forms clusters with vehicles which are moving in the same direction. The link will be maintained only if there is at least one header in the intermediate

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cluster. Since, only the header needs to find the destination path, the routing overhead is less and it is proportional to the number of clusters. Other cluster based routing protocols include Clustering for Open IVC Network (COIN), Location Routing Algorithm with Cluster Based Flooding (LORA_CBF) Cluster Based Routing (CBR), Cluster Based Directional Routing Protocol (CBDRP), Traffic Infrastructure Based Cluster Routing Protocol with Handoff(TIBCRPH), and Mobile Infrastructure Based VANET Routing Protocol (MIBR)

4.3. HYBRID PROTOCOLS

Hybrid routing protocols combine the advantages of both proactive and reactive approaches. In hybrid protocols, the network is divided into two levels. The inner layer is proactive, which maintains and updates information on routing between all nodes of a given network at all times. Route updates are periodically performed regardless of network load, bandwidth constraints, and network size. Inner layer comprises easy-to-maintain routes, where a routing table is maintained, whereas the outer layer is reactive, the route is determined on need basis. Thus, if a node wishes to initiate communication with another host to which it has no route, a global-search procedure is employed.

GeoDTN+Nav combines DTN and NonDTN mode, which includes a greedy mode, a perimeter mode and a DTN mode. It switches from non-DTN mode to DTN mode by estimating the connectivity of the network based on the number of hops a packet has travelled so far, neighbor's delivery quality, and direction of neighbor with respect to the destination. The delivery quality of neighbors is obtained through virtual navigation interface, which provides necessary information for GeoDTN+Nav to determine its routing node and forwarding node. In sparse network, the latency increases and the packet delivery ratio drops at which point GeoDTN+Nav tries to fall back to DTN mode again.

4.4. BROADCAST ROUTING PROTOCOLS

This is the most frequently used routing protocol in VANETs, especially in safety related applications. In broadcast mode, a packet is sent to all (even unknown or unspecified) nodes in the network and in turn each node re-broadcasts the message to other nodes in the network. Flooding is a prominent technique used in broadcast routing protocols. However, blind flooding results in broadcast storm problem. A broadcast storm can overload the limited channel capacity, causing channel congestion that reduces communication reliability. Broadcast protocol is suitable only for small number of nodes in the network. As the density of nodes increases, there is an exponential increase in message transmission, which results in higher bandwidth consumption. The broadcast routing protocols are classified into traffic based, area based, cluster based and probability based routing protocols.

4.4.1.Traffic based Broadcast Routing Protocols

In traffic based broadcast routing algorithm, a source node broadcasts a packet to all its neighbors and each of those neighbors, in turn, re-broadcast the packet exactly one time. This process continues until all the reachable network nodes have received the packet. The Distributed Vehicular broadcast protocol (DV-CAST) uses local one-hop neighbor topology to make routing decisions. The protocol adjusts the back-off timer based on the local traffic density, and computes connectivity in forward and opposite direction with periodic heartbeat messages. This protocol divides the driving environment into three types of regions depending on the local

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connectivity as *well-connected, sparsely connected and totally disconnected* neighborhood. In well-connected network, it applies any one of the broadcast suppression schemes using probability:
Weighted p-persistence or slotted 1 persistence or persistence. In sparsely connected neighborhood after receiving the broadcast message, vehicles immediately rebroadcast it to vehicles moving in the same direction. In totally disconnected neighborhood vehicles are used to store the message until another vehicle enters into transmission range, otherwise if the time expires it will discard the packet. DV-CAST addresses how to deal with extreme situations such as dense traffic conditions during rush hours and sparse traffic during certain hours of the day. However, this protocol is attributed with high overhead and end-to-end delay during data transfer.

4.4.2.Area based Broadcast Routing Protocols
Area based routing protocols use the concept of coverage area to adjust the rebroadcast region within the specified geographical area. In this scheme, every vehicle receives multiple packets which may contain overlapping information. Scrutinizing these messages provides additional coverage area. The node that is farther away from the source is preferred for re-broadcast to widen the coverage area.

4.4.2.1.Distance and Hop based Routing Protocols
In distance and hop based methods, messages are broadcast by considering the neighboring distances and hop count from the transmitting node. The distance between the source and destination is the criteria for deciding whether to re-broadcast to destination or drop the message. Fast Broadcast (FB), a distance based routing protocol, minimizes forwarding hops during transmission of messages. It works in two phases viz. *estimation phase*, in which the transmission range is adjusted using heart beat messages to detect backward nodes and *broadcast phase*, in which the message is transmitted by assigning higher priority to the vehicles that are farther away from the source node. Cut-Through Rebroadcasting (CTR) gives higher priority to rebroadcast alarm messages to farther vehicles within the transmission range but operates in a multi-channel environment. Optimized Dissemination of Alarm Message (ODAM) has a defer time to broadcast messages, which is computed based on the distance between source node and receiver node. Broadcast of messages can only occur within risk zone area, determined with a dynamic multicast group based on vehicles proximity to the accident site.

4.4.2.2.Location Based Routing Protocols
In location based methods, messages are broadcast based on the geographic area of the vehicles. Each node adds its own location in the header of the message, which is used by the receiving node to calculate the additional coverage area to re-broadcast. The main problem with this approach is the cost of calculating additional coverage areas. Location Based Broadcast (LBB) protocol is designed to meet the communication requirements of highway safety applications. In Location Based Broadcast, sender broadcasts messages to all receivers in its communication range. It is the receiver's responsibility to determine the relevance of message and provide proper response. The decision is made based on the relative position of the sender (in front, behind, left lane etc.), the purpose of the message (brake warning, lane change warning, accident reporting, congestion prediction, etc.) and the highway traffic condition. Urban Multi-Hop Broadcast Protocol (UMB) and Ad hoc Multi-hop Broadcast (AMB) are designed especially for multi-hop

broadcast in urban scenarios addressing broadcast storm problem, hidden node problem and reliability issues. Each node during broadcasting, selects the farthest node to forward the message. UMB protocol efficiently broadcasts packets with high delivery ratio using repeaters installed at junctions. Whereas AMB protocol solves the infrastructure dependence of the UMB Protocol. It is extension of the UMB protocol composed of two parts, namely *directional broadcast* and *intersection broadcast*. Multi-Hop Vehicular Broadcast (MHVB) is a flooding algorithm, which assumes availability of GPS device for position information. It implements congestion suppression algorithm and adopts backfire algorithm to select the farthest forwarding node to relay the message efficiently. In enhanced MHVB, angle is added as a parameter to the backfire algorithm. V-TRADE/HVTRADE organizes nodes into groups, where only a small subset of vehicles is selected to re-broadcast the message. These protocols show considerable improvement in performance, but they incur a routing overhead in selecting nodes to do the re broadcasting. Epidemic routing is introduced as an alternative approach for partially connected ad hoc networks. It exchanges random pair-wise messages among mobile nodes. It is specifically designed to address the issues related to (i) selection of next hops, which will lead to successful transmission (ii) forwarding inefficiencies including cycles associated with the beacon messages (iii) failure of message delivery due to disconnected topologies and (iv) data packet reaching local optimum in trajectory based routing schemes. BRAVE performs hop-by-hop data forwarding along a selected street using opportunistic next hop selection method. It uses a reactive scheme for the selection of the next forwarder from those neighbors who have successfully received the message instead of using period beacon messages. In addition, this protocol works in a opportunistic store-carry-and-forward paradigm to cope with uneven network densities and disconnected topologies. BRAVE is fully localized protocol requiring information only from neighbors, which guarantees scalability with respect to the number of vehicles in the network. Ad Li *et al* propose a distance based broadcast protocol called Efficient Directional Broadcast (EDB)which is composed of two parts viz. directional broadcast on the road and directional broadcast at the intersection. At the intersection, a directional repeater is installed which is used to forward the message to vehicles on the different road segments incident to the intersection of different directions. It has many advantages including long transmission range, space reuse, low redundancy and collisions.

4.5. MULTICAST/GEOCAST ROUTING PROTOCOLS

Multicast routing enables dissemination of messages from single source to a group of destination nodes of interest. Geocast routing is basically a location based multicast routing, which aims to deliver information from a source node to all other nodes within a specified geographical region called a Zone of Relevance (ZOR). A Zone of Forwarding (ZOF) is defined within which the packets are directed instead of simply flooding the packets everywhere in the network. This reduces the overhead and network congestion. This protocol is applicable for safety and convenience related applications. The various Multicast/Geocast routing protocols are described in the following sections.

4.5.1 Topology based Approaches

Topology based approaches select forwarding nodes based on the network topology information, which can be either multicast tree or multicast mesh. A multicast group is not constrained by a particular location; a group of members can be defined by unique and logical group identification such as class-D IP address. Robust Vehicular Routing (ROVER) is a reliable geographical

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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 ZOR. When a vehicle receives a message, it accepts the message if it is within the ZOR. It also defines a ZOF, which includes the source and the ZOR. All vehicles in the ZOF are used in the routing process.

4.5.2 Location based Approaches

Location based approaches select forwarding nodes based on location information such as the position of sending/receiving nodes, the position of neighbouring nodes, and the coordinates of a multicast region. Since forwarding nodes are selected during dissemination of each multicast packet, there is no need to maintain multicast trees and hence less overhead. These protocols are further divided into two schemes: approaches with location-independent and approaches with location-dependent. Inter-Vehicles Geocast protocol (IVG) is developed for disseminating safety messages to vehicles on highways. The multicast group is defined dynamically using vehicles within the risk area, which is determined by the driving direction and position of vehicles. This group is defined temporarily and dynamically by the location, speed, and driving direction of vehicles. This protocol uses a timer based mechanism for forwarding messages and periodic broadcasts are used to overcome network fragmentation for delivering messages to the multicast members. The rebroadcast period is calculated based on the maximum speed of vehicles. Besides, IVG protocol reduces the number of hops by using the deferring time. A vehicle, which is farthest from the source node, has less deferring time to rebroadcast. GvGrid , a QoS routing protocol for VANETs is an on-demand, position based protocol. GVGrid partitions maps into equal-sized grid squares where a node selects the next hop node from its neighbouring grids. Select a route consisting of vehicles which are likely to move at similar speeds and in similar direction. GvGrid implements an efficient route recovery algorithm which does not construct a new route altogether but identify the new nodes that complement the missing nodes and recovers a high quality route quickly. The main aim of Dynamic Time-Stable Geocast Routing (DTSG) is to maintain the availability of the messages for a certain period of time within the area of interest. Time stable geocast protocol finds place in commercial applications in addition to accident emergency warning applications. It works in two phase viz. pre-stable period and stable period. DTSG protocol guarantees delivery of message to the intended vehicles entering the region for a certain amount of time and it works well even in sparse networks. The performance of this protocol is independent of the density of vehicles, speed of vehicles, and the broadcasting range, which makes it more robust.

4.6. HIERARCHICAL ROUTING PROTOCOLS

Clustering permits large networks to be managed efficiently as hierarchical structures. Partitioning nodes into clusters forms a single hierarchy, whereas, in a multilevel hierarchical routing, nodes are organized into a tree-like structure with multiple levels of clusters. Overlapping clusters is often a desirable feature, which can significantly reduce the number and duration of interruptions in communication when the network gets partitioned due to moving nodes. However, one should be cautious of hidden terminal problem in the overlapping region. The efficiency of distributed clustering schemes depends on the number of clusters formed and the goal is to reduce the number. In hierarchical routing, paths are recorded between clusters instead of between individual nodes due to which the stability of the route is increased. Hierarchical clustering provides scalability for large networks, and stability for dynamic networks. It is an attractive approach to address broadcast storm problem as well.

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The inter-cluster and intra-cluster routing protocols, as the names suggest, take care of the communication within and between the clusters respectively. DPP is a distributed algorithm which works irrespective of the traffic density The BROADCOMM protocol uses a two level hierarchical structure for highway networks. The first level is a virtual cell of nodes and second level is a collection of cell reflectors, which are few nodes that are located close to the geographical centre of the cell. The cell reflectors act as cluster heads and handle the emergency messages from the members of the cell or from the neighboring cells. Hierarchical Cluster Based Routing (HCB) is a novel protocol designed with two-layer communication architecture and suitable for highly mobile ad hoc networks. In this protocol two types of nodes are present; one with single Wi-Fi interface and they communicate via multi-hop path and another one is called super node with Wi-Max or HSPA for long range communication. Layer-1 comprises simple nodes and one or two super nodes whereas layer-2 consists of only super nodes.

4.7. ADAPTIVE/CONTEXT-AWARE ROUTING PROTOCOLS

The network topology in VANET scenario by itself is an emerging phenomena based on the interactions of the vehicles. An adaptive approach is essential to deal with the current network conditions and to cope with the problems of network distortions due to radio signal interference and node movements. Adaptive routing algorithms, in general follow two approaches viz. context aware protocols and swarm intelligence based protocols.

The main concept of swarm intelligence is the collective intelligence; a large number of participating agents, which are individually not intelligent but through emerging behavior they achieve much bigger task collectively, which is beyond the capabilities of individual agents. They perform highly complex tasks of global optimization using only local information without a centralized coordination. Ant Colony Optimization (ACO) is another well-known bio-inspired technique designed to solve hard combinatorial optimization problems. Among the different multi-agent coordination mechanisms, the most popular is the use of stigmery. For the development of adaptive routing protocols, two mechanisms related to stigmery are of most importance: the way the pheromones are deposited in the paths of the ants and the way these evaporate within the passage of time Successful implementations of swarm intelligence include Ant Net and Ant Based Control(ABC). Ant Net uses two types of ants: forward ants and backward ants. Forward ant explores network to find path to destination and backward ant re-enforces the path from destination to source. The routing table is updated using the trip times of the backward ants. In ABC algorithm, the routing table is updated based on the life of the ant, which is the sum of the delay of the nodes. These algorithms exhibit robustness under various network conditions but lack scalability. For large networks, the amount of traffic generated is huge, since each node has to send an ant to all nodes of the network. For longer distances, there is a chance of losing ants and for large travelling times ant’s path is out dated by evaporating pheromone substance. Adaptive Swarm based Distributed Routing (A-SDR) addresses the problem of scalability by clustering the nodes into colonies. It uses a local ant to discover routes within the colony and a colony ant to discover route across colonies. It also addresses full utilization of the network capacity, routing oscillations and routing loops.

5. CONCLUSION

Design of efficient routing protocols for VANET is one of the major challenges to be addressed in order to leverage the benefits of the VANET technology to day-today life. Performance of routing protocol for VANETs depends drastically on the mobility of nodes, vehicular density and several external factors such as driving environment. It also depends on the use of appropriate mobility model and propagation model. The protocol should perform well in both dense and sparse traffic conditions either in city or highways seamlessly. A universal routing solution for all VANETs application scenarios may not be viable; we need to design specific routing protocol and mobility model to fulfill the specific Quos requirements of each application. Safety related applications are hard real-time in nature and demand very low latency and guaranteed delivery of packets. Both uncast and broadcast protocols find place in safety related applications. Even though flooding is a technique suitable for such applications, blind flooding leads to broadcast-storm problem and results in fragmentation in network. An intelligent and optimized broadcast protocol is required to alleviate these issues. Even though convenience and comfort applications demand low latency, effective use of available bandwidth and ensuring better packet delivery ratio are of paramount importance. These applications also demand that the routing protocol should scale well with the increase in the number of users/vehicles and should adapt to different environment/traffic scenarios seamlessly. Multicast and Geocast protocols are preferred over flooding techniques in order to ensure end-to-end quality of service. Automated highways applications demand the intelligent use of information disseminated to make safe and appropriate decisions in real time in any traffic situation for autonomous driving.

It is obvious that topology based protocols do not scale well for VANET environment. With the proliferation of GPS based services, position based protocols are becoming popular. In addition, position based methods do not have the overhead of establishing and maintaining routes. Most commonly used forwarding strategies by position based protocols include greedy forwarding and trajectory based forwarding. Position based routing methods suffer from finding the exact localization of the vehicles due to the inherent inaccuracy of the GPS location. Delay tolerant network technique uses the store and forward method. This guarantees the delivery of data but suffers from large delay, which makes them not suitable for emergency related applications.

In this paper, we reviewed a large number of routing protocols that are available in the literature and categorized them concisely in the form of a taxonomy based on key attributes. This survey is part of the research work, which aims to develop a generic architecture for ITS to support safety, convenience and comfort applications using layered multi-agent approach. This involves design and integration of different routing protocols meeting the quality of service requirements of the applications in each layer.

REFERENCES

[1] Venkatesh, Indra. A and Murali. R, "Vehicular Adhoc Networks (VANETs): Issues and Applications", Journal of Analysis and computation, Vol. 8, No. 1, 2012,

[2] Andrei Furda et al, "Enabling Safe autonomous driving in real-world city traffic using multiple criteria decision making", IEEE Intelligent Transportation System Magazine,

[3] S S Manvi and M S Kakkasageri, "Issues in Mobile Ad hoc Networks for Vehicular Communication"**,** IETE Technical Review, Vol. 25, No 2 March- April 2008.

[4] Alexandru Dorin et al, "MAC Protocols for VANETs - A Survey and Qualitative Analysis", Albert-Ludwigs-University Freiburg, seminar paper, February 2010.

[5] Y. Saleh, et al., "Vehicular ad hoc networks (VANETs): Challenges and perspectives", in Proc. 6th Int. Conf. on ITS Telecommunication 2006 .
[6] Fan Li and Yu Wang, “Routing in Vehicular Ad hoc Networks: A Survey”, IEEE Vehicular Technology Magazine,Vol. 2 June 2007.
[7] Hasnaa Moustafa, et al, “Adaptive Path Energy Conserving Routing in MANETs”, Ad Hoc and Sensor Wireless Networks, Similar Publications 2005.
[8] Ajay Guleria, et al, “Request Analysis and Dynamic Queuing System for VANETs”, International Journal of Advanced Computer Science and Applications, Vol. 3, No. 10, 2012.
[9] A.Manikandan, et al, “Analysis of mobility models framework for vehicular ad hoc networks”, International Journal of Scientific and Engineering Research Volume 3, Issue 8, August-2012, pp. 1-8.
[10] Qing Yang, “Connectivity Aware Routing in Vehicular Networks”, IEEE Communications and networking conference, April 2008
[11] Yun-Wei Lin et al, “Routing Protocols in Vehicular ad hoc networks: A survey and future perspectives”, Journal of information Science and engineering, 2010
[12] S. Jaap, et al., "Evaluation of routing protocols for vehicular ad hoc networks in city traffic scenarios," in Proc. 5th Int. Conf. On Intell. Transprtn. Systems Telecommun.

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