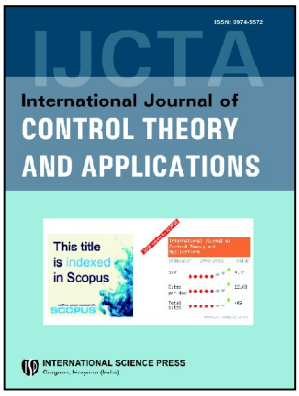

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An Extensive Study of Various Routing Protocols in VANET

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Abstract: Vehicular Ad Hoc Network (VANET) has drawn potential significance in last decade; it is the evolving field of MANETs where vehicles act as the mobile node within the network. **Objective:** The aim of this paper is to review several routing protocol used in vehicular network, this survey is essential to select a best routing method for safe information dissemination. **Communication**: It provide vehicle to vehicle and vehicle to roadside wireless communication. **Findings:** In this paper, different routing protocols were surveyed and their merits and limitations have been discussed. The design of routing protocols is prominent for vehicular networks to route messages dynamically and assures that routing paths should not susceptible to break the connection before the end of data transmission. **Novelty/Improvement:** Routing is a difficult problem because the network topology is dynamic and the communication links are innately unstable, due to high node mobility. In this research work we enlighten different routing protocols which have been proposed in last few years. For future improvement, we will implement our proposed routing protocol based on highway traffic.

Keywords: VANET, Communication network, Routing protocol

1. INTRODUCTION

A Vehicular Ad-Hoc Network or VANET is a technology that uses moving vehicles as nodes in a network to create a mobile network. VANET turns every participating vehicle into a wireless router or node. It eliminates frequent disconnection of network and act as server and client. The vehicular communications met numerous initiatives of the research that enhance security and efficiency of transportation systems, for example, acknowledgments of the ambient conditions (snow, fire, etc.), and traffic in the road conditions.

The main challenge is designing an efficient routing protocol for vehicular communication because the traditional Ad-hoc routing protocols [12] are not expedient for VANET. Figure.1 shows the typical architecture of VANET.

This paper is organized into five sections. The section-2 conveys the communication archetype. The different routing protocols are briefly studied in the section-3. Finally, it is concluded in the section-5.

2. VANET COMMUNICATION ARCHETYPE

The topology created for vehicular communication is usually dynamic and the nodes are distributed non-uniformly due to the varying speed of vehicles.

In order to transfer information about these kinds of networks, designing an efficient routing algorithm is vital. The availability of navigation system on each vehicle makes it aware of its geographic location as well as its neighbours.

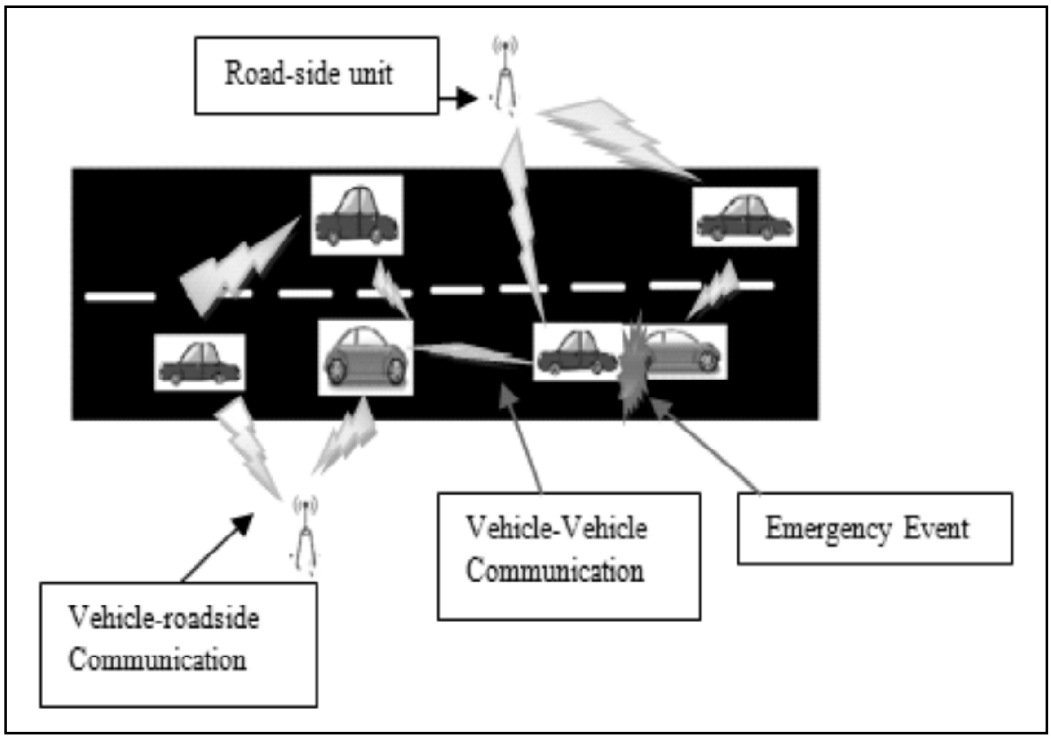

Figure 1: VANET Architecture

2.1. Vehicle to Vehicle (V-V) communication

V-V communication has a bigger impact than the advanced vehicle automation technologies that have been widely promising. Though self-driving cars could ultimately improve safety, but they remain faulty and unproven, additionally these type of cars used with sensors and software too easily bamboozled by unconditioned weather, unexpected obstacles, or complex city driving. Simply the vehicles communication through wireless is likely to have a massive effect on road safety. An intelligent transport system (ITS) [12] use the data from V-V communication to improve traffic management by allowing vehicles to communicate with road-side unit, such as traffic lights and signs. V-V is an inter vehicle communication which is purely infrastructure free, only the in-vehicle or tampering equipment is needed. Inter- vehicle communication works in both single and multi-hop networks, single hop is a short-range communication where multi-hop is a long-range communication. Main application of this communication covers co-operative driving, consumer assistance (warning/speed alerts).

2.2. Vehicle to Infrastructure (V-I) communication

Vehicular information is also available from roadside units. V-I communications use the 63 GHz band [12].This very high frequency provides a very high bandwidth link with roadside beacons. The important application of vehicle-to-infrastructure communication is ETC (Electronic Toll Collection), which allows electronic payment

of highway tolls. The payment transaction occurs between a vehicle passing through a toll station and the toll agency, it require Onboard Units (OBU) for vehicle detection and classification.

3. ROUTING PROTOCOLS

Data's in network is routed over a network by three methods unicast, broadcast and multi-cast. In unicast routing the connection is established from a source to destination. In broadcast routing the connection is established from a source to available destinations at a time. In multicast routing the connection is established from a source to multiple destinations.

3.1. Position-based routing protocol

This protocol is restricted for bi-directional communication; it gets information like geo maps, traffic details. It is widely used in urban and highway traffic. In this protocol packets are forwarded using greedy and A-star routing.

3.1.1. Greedy routing protocol

It forward packets from source to destination but fails with local minimum.

This routing protocol is not suitable for city traffic because direct communication between nodes is not possible due to obstacles.

3.2. Geo-cast routing protocol

Geo cast routing protocol is a location based multicast routing. Its aim is to deliver the packet in specified geographic region. This protocol is based on directed flooding in order to reduce message overhead and network congestion. It provides non-directed flooding based on unicast routing, it helps to avoid packet collision and reduce the number of rebroadcasts but the packet have to wait longer. Packet delivery is reliable but transmission delay is high due to network disconnection. The route discovery and management is not required in this protocol. One pitfall of Geo cast is it requires position determining service. Abiding geo cast is a time stable scheme used in ad hoc network; it enables virtual traffic sign (warning).

3.3. Cluster-based routing protocol

In this protocol small group of vehicles form a cluster and the size of cluster depends on routing algorithm. Vehicles having similar characteristics like velocity, direction are grouped together. If the packet to be sent in the same cluster then it is done by using the direct path, but when the destination node is outside the cluster then the cluster head create a virtual network. It is good in scalability but failed to cover delay and overhead. Cluster head is responsible for the communication between source and destination.

- Inter-cluster ,and
- Intra-cluster communication

In inter-cluster communication the data are disseminated within the single cluster. In intra-cluster communication the data's are disseminated between different clusters.

3.4. Broadcast routing protocol

This protocol is mainly used to deliver advertisement and announcements, sharing traffic, weather and emergency warning.

It supports both unicast and multicast routing. Minimize overhead by occurrence of broadcast storms. Packet is delivered via number of nodes so the transmission is reliable. It consume large amount of network bandwidth.

3.4.1. Urban Multi-hop routing

This protocol is designed to overcome packet collision, interference and hidden node problem, widely used in higher transmission range.

3.5. Topology-based routing protocol

This protocol can send unicast, multicast and broad cast type of messages. It uses available information in the network to forward packets from source to destination. Due to dynamic node in VANET it fails to discover route. So, overhead is higher and delay minimization is less.

- Table-driven(proactive),
- On-demand(reactive) routing

In proactive, it creates new lists of route to destination periodically, whereas in reactive, to finds a route it floods the network.

4. DISCUSSION

Microscopic mobility is used to analyse the realistic highway traffic, over time and space. It integrates road topology and data extracted from database. The database is a real time performance measurement system. This analysis includes node degree, link duration, and number of clusters with neighbour distribution, closeness centrality, size of the largest cluster, and clustering coefficient[1].

To reduce delay in large-scale VANETs the region-based store -forward framework is used, here the drop boxes are used as routers. The drop box then stores the message until it finds a suitable vehicle and transfers the message to it.

The optimal routing algorithm is implemented based on the theoretical delay analysis in terms of which types of vehicles to piggyback and how long the message should wait for them[2].

Greedy opportunity forwarding algorithm is implemented to respond to the impacts of the multilevel structure. The measured data and analysis results show that the wireless transmission range dramatically degrades, which deteriorates the probability of connection[3].

New hybrid routing protocol for communication between buses and operation control centre based on a Public Transportation System is implemented.

The bus location must be updated each 30 seconds[4].

The distance-based routing protocol for urban traffic environments is implemented, widely used in multi-hop broadcast scheme for reliable packet dissemination and stable route decision scheme based on the adaptive waiting time. Route discovery is designed based on the intersection waiting time mechanism in order to prevent disconnection due to obstacles .It enables to disseminate packets toward all directions of an intersection for effective route discovery. Stable relay node decision scheme is designed based on the adaptive waiting time mechanism which is prioritized with a relative distance and velocity between a sender and neighbouring nodes[5].

Hybrid architecture, combining IEEE and the (4G) cellular system, i.e., Long-Term Evolution is implemented with the goal of achieving high packet delivery and low delay. Data forwarding is depends on its clustering state. Cluster head selection using the relative mobility metric.Cluster update is periodic[6].

Table 1
Comparison of different routing protocols

Title	*Protocol / Technology used*	*Scale*	*Traffic Flow*	*Digital Map Requirement*	*Simulator used*	*Merits*	*Limitations*
Multi hop-Cluster-Based Hybrid Architecture for Safety Message Dissemination[6]	IEEE 802.11,LTE (4G cellular technology)	medium-high	Highway	no	ns-3	Higher reliability, Reduce clustering overhead	Packet delivery cost is higher
Vehicular stable cluster- based data aggregation[21]	Data aggregation, Form stable cluster based on state transition	high	Highway	no	ns-3	Efficient and scalable communica-tion	Lack of delivery speed
An Evolving Graph-Based Reliable Routing Scheme for VANETs[18]	Evolving Graph-Dijkstra algorithm	low-medium	Highway	no	OMNeT++	Determine reliable routes, facilitate quality of service	Increase in delay according to packet size
Intelligent OLSR Routing Protocol Optimization for VANETs[17]	Optimized Link State Routing	high	Urban traffic using digital maps	yes	ns-2	Calculate routing path longer than others, scalable and better quality of service	Maintaining routing table for all paths cause network congestion
Delay Minimization for Data Dissemination in Large-Scale VANETs with Buses and Taxis[2]	store-and-forward framework, optimal link strategy and drop-box to store message	medium-high	Based on fixed time public transit system	yes	Monte Carlo	Ignore dependencies of delay component	Routing problem arise
Geographic Routing in Multilevel Scenarios of VANET[3]	Greedy opportunity routing protocol and Greedy opportunity forwarding	low-medium	Different highway Lane	no	Monte Carlo	Increased delivery ratio and decrease hop count	Node distribution is complicated
A Routing Protocol for Urban VehicularMulti-hop Data Delivery[5]	Distance based routing protocol, Intersection-based route discovery	medium	Urban traffic	yes	QualNet	low overhead, high through put	Based on distance waiting time may vary
An enhanced for VANET using trust computing algorithms[20]	Optimized Node Selection routing protocol	high	Highway or Urban	no	ns-2	Reduce link failure and enhance performance metric	Direction and distance calculation cause overhead

contd. table 1

Reference	*Routing protocol*	*Scale*	*Traffic flow*	*Digital map requirement*	*Simulator used*	*Merits*	*Limitations*
Vehicle Mob & Comm Channel Models for VANET Simulation[1]	Microscopic mobility model	medium	Four different Highway LANEs	no	OMNeT++	Analysis and integrate four different highway traffic low	Depends on vehicle density
GeOpps-N: for VANET in a Public Transit System[4]	Geographic routing	medium-high	Based on public transit system	yes	OMNeT++	End-End delay is minimised	Density of network is low

Optimized Link State Routing deals with the optimal parameter and it is well suited for high density networks, where most of the communication is concentrated between a large numbers of nodes. Using this protocol the status of the links is immediately known, and it is possible to extend the information that is exchanged with data .It allow the hosts to know the quality of the network routes in advance[17].

An evolving graph theory is implemented to model a communication graph based on highway traffic. This routing scheme facilitates quality-of-service to find the most reliable route from the source to the destination. The result achieves the highest packet delivery ratio, and it obtains the lowest routing request ratio because the broadcasting technique is not needed in the route discovery process. As it chooses the most reliable route to the destination, it achieves the lowest number of link failures, the highest route lifetime, and the lowest average delay values[18].

Node selection routing protocol using trust model is designed to find the optimized node for transmission of data from source to destination. Each node maintains a flag value; a database routing table is maintained to store the trust information of neighbor node.If a destination node detects a weak link then it notifies to its source node, then the source node create and update its flag[20].

Stable cluster architecture is implemented based on data aggregation.

The cluster is formed using state transition of vehicles. Aggregation is applied before forwarding the data packets and it achieves 70% of packet delivery ratio. Each cluster consists of vehicle information base it is a repository of storing information of vehicle and its neighbor[21].Table 1 shows the comparison of different routing protocols.

5. CONCLUSION

Different issue in VANET routing protocols were analysed in this survey. Their merits and limitations have been discussed. The purpose of this survey shows the adaptive nature of the protocol with different traffic flow and how information is disseminated in realistic traffic based on path selection.

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