IVANET: An Improved Vehicular Ad Hoc Network

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Abstract—A Vehicular Ad-hoc Network (VANET) is subset of Mobile Ad-hoc Network (MANET) which basically serves as a mode of interaction among vehicles and predetermined infrastructure on the wayside. It has become dynamic region of research and development for the reason that it has incredible potential to get better vehicle and road safety, traffic competence and ease to both driver as well as passenger. Besides the advantages of VANET, there are number of challenges in VANETs such as conditioning of QoS (Quality of Service), high connectivity, bandwidth, security to vehicle and individual privacy. In this paper, we provide an overview of the main aspects of VANETs for a research perspective. This paper starts with the basic introduction of network in form of applications, models; protocols etc., then discussed research issues, proposed solutions and ends up with the conclusion as expected results and future scope.

Keywords—Vehicular Ad-hoc Network (VANET), Mobile Ad-hoc Network (MANET), QoS (Quality of Service), Packet drop, delay, security

I. INTRODUCTION

The key principles of mobile ad hoc networks (MANETs) are used to create Vehicular ad hoc networks (VANETs) that shows the sudden creation of a wireless network for data exchange to the domain of vehicles. In VANETs the synchronization of vehicle-to-vehicle and vehicle-to roadside communication is seen in order to provide safety of road, navigation, and other services of roadside. The principle part of Intelligent Transportation Systems (ITS) framework are VANETs, so those are also called as Intelligent Transportation Networks generally. The keen interest in the field of VANETs has been inducted over the last few years because of the current advancement in the field of wireless communication technologies and auto-mobile industry.

A. Characteristics of VANET

Though VANET could be treated as a sub set of Mobile Ad Hoc Networks (MANETs) but it is still necessary to consider VANETs as a unique field of research, especially in the field of security management. The unmatched features of VANET include:

- High Dynamic Topology: The Dynamic Topology of VANET is characterised by the swiftness and the preference of the route.
- Frequent Disconnected Network: The above characteristic requires that the nodes need another route with nearby vehicle to maintain flawless connectivity in about every 5 seconds or so on.
- Mobility Modelling and Prediction: For efficient network design the mobility model and node anticipation based on study of already defined roadways model and vehicle speed is of at most importance.
- Communication Environment: There is a drastic variation in the mobility model from highways to that of the city environment. Hence these mutations must also be accommodated by the node prediction design and routing algorithm also.
- Unlimited Transmission Power: The power can be provided to the computing and communication devices by the node itself.
- Hard Delay Constraints: The safety facet (such as accidents, brake event) of VANET's relevance depends on real time delivery of message to concerned nodes.
- Interaction with onboard sensors: The node location and their movement nature that are used for effective communication link and routing functions are provided with the help of concerned sensors.
- Higher Computational Capability: Substantial, calculating, communication and sensing potential can be afforded by the operating vehicles.
- Rapidly Changing Network Topology: The network topology in VANETs tends to modulate oftenly due to higher node mobility.
- Potentially Unbounded Network Size: Vehicles in one city, several cities or even a country could be evolved by the VANETs.
- Anonymous Addressee: Instead of explicit vehicles, most of the vehicles in VANETs require exclusive recognition of the vehicles in a particular region.
- Time Sensitive Data Exchange: Most security related applications demand data packet transmission in a synchronized manner.
- Potential Support from Infrastructure: Unlike usual MANETs, VANETs can actually take advantage of architectural foundation in the future.
- Abundant Resources: VANET nodes have surplus energy and computation resources.

- Better Physical Protection: VANET nodes are more secured than MANETs.
- Partitioned Network: Vehicular networks will be oftenly partitioned [2].

II. APPLICATIONS

A large number of applications are supported by VANETs - from normal one hop information propagation of, e.g., cooperative awareness messages (CAMs) to multi-hop broadcasting of messages over wider area. The characteristics of mobile ad hoc networks (MANETs) pertaining to vehicular ad hoc networks(VANETs) are of keen interest in VANETs, but the characteristics differ instead of moving haphazardly, vehicles tend to move in an synchronized and organized manner. The communication with wayside devices can similarly be differentiated accurately. And finally, most of the vehicles are prohibited in their area of motion, for example by being restricted to follow a tiled highway.

- Electronic brake lights, which allow a driver (or an autonomous car or truck) to respond to vehicles braking even though they might be incomprehensible (e.g., by other vehicles).
- Electronically coupled "road trains" are formed by platooning, which allows vehicles to closely (down to few inches) pursue a foremost vehicle by wirelessly receiving acceleration and navigation information.
- VANET communication is utilized to make available up-to-the minute barrier reports to a vehicle's satellite navigation system by Traffic Information Systems.
- Road Transportation Emergency Services: To decrease delays and accelerate emergency recovery operations to save the lives of those affected , VANET interactions, VANET networks, road safety caution and status information broadcasting are used.
- On-The-Road-Services: It is also predicted that future transportation highway would be one that is "information-driven" and "wirelessly-enabled". When one will drive on the road, VANETs will help the driver to find services (shops, gas stations, etc) along that street, and even be informed of any sale going on at that instance [1].

III. VANET ROUTING PROTOCOLS

Proficient routing and appropriate network management are the most important networking functions included in VANETs. The routing protocols are differentiated into five categories in VANETs. They are as follows:

- Topology based routing protocol
- Position based routing protocol
- Cluster based routing protocol
- Geo cast routing protocol
- Broadcast routing protocol.

These protocols are differentiated on the basis of area where they are most appropriate.

- **Topology based routing protocol**: Detail of links that subsist in the network to do packet forwarding is utilised by the routing protocols. They are subsequently differentiated as follows:
  - **Proactive Routing Protocols:** In this routing information like data or address of the subsequent forwarding hop is preserved in the environment regardless of the communication requests. Its reward is that there is no route discovery since the final end route is stored in the background. The different types of proactive routing protocols are: FSR, DSDV, OLSR, CGSR, WRP, and TBRPF.
  - **Reactive Protocols/ Ad hoc based routing protocols:** In this the link is opened only when it is required by a node to communicate with the other node. It consists of route discovery stage in which the query packets are afloated into the network for the route search and this stage completes when the route is found. The different types of reactive routing protocols are AODV, PGB, DSR, TORA, and JARR.
  - **Hybrid Routing Protocols:** To decrease the restraining overhead of proactive routing protocols and decline the initial route discovery delay in reactive routing protocols, hybrid protocols were established.
- **Position Based Routing Routing Protocols:** It comprises of a group of routing algorithms. In order to identify the subsequent hops they disseminate the property of geographic positioning information. These are broadly classified into two types:
  - Position based greedy V2V protocols and
  - Delay Tolerant Protocols.
- **Cluster Based Routing Protocols:** In cluster based routing. A cluster of nodes recognize themselves to be a part of group and a node is nominated as a cluster head will disseminate the packet to cluster. For bigger networks good scalability can be provided but network delays and overhead are acquired while cluster in highly mobile VANET. The different Clusters based routing protocols are COIN, LORA-CBF, TIBCRPH, and CBDRP.
- **Geo Cast Routing Protocols:** Geo cast routing is basically a position based multicast routing. Its aim is to deliver the packet from initial node to all other subsequent nodes within a specified geographical boundary. The different Geo cast routing protocols are IVG, DG-CASTOR and DRG.
- **Broadcast Based Routing Protocols:** In VANET for sharing, traffic, weather and emergency, way conditions among vehicles and delivering advertisements and announcements broadcast routing is oftenly used. The different Broadcast routing protocols are BROADCOMM, UMB, V-TRADE, and DV-CAST.

All these active routing tactics are responsible for subsequent metrices: Decreasing end-to-end delay, Increasing end-to-end

throughput, compatible to dynamic topology and Packets are always routed through optimal path [3][4].

IV. VANET MODELS

VANETs are large and complex system model, which consist of four sub-models related to various aspects:

(i) **Driver and vehicle model:** To show the character of a particular vehicle is the main goal of this model. This behaviour requires to indulge two main factors: various driving styles and the vehicle specifications, such as an aggressive or passive driver and a sports car.

(ii) **Traffic flow model:** To show communication among vehicles, drivers, infrastructure and development and most suitable path network is the major goal of this model. Various categories of traffic flow models are: microscopic, mesoscopic, and macroscopic.

(iii) **Communication model:** To tackle the data commutation among the road user, this model is very important part of research methodologies.

(iv) **Application model:** For market introduction, this model is very important as it can address the nature and standard of cooperative VANETs applications. This kind of model is necessary for various vehicle manufacturers to offer diverse functionality and visualizations for cooperative applications [5].

V. PROBLEM FORMULATED AND PROPOSED SOLUTIONS

A. Problem: Packet Drop:

Proposed Solution:

In VANET we can apply different efficient scheduling algorithms/methods at the node after detecting the traffic like FCFS (for less traffic), SJF (for moderate traffic) and Priority (for high traffic) to minimise the rate of packet dropping.

B. Problem: Delay in Connection

Proposed Solution:

The principle problem of delay in connection occurs because of finding the best suitable node to connect (which is nearest) and due to high mobility the connection is established only for 5seconds atmost . At the point efficient (in terms of time complexity) Shortest Path algorithm can be applied over the node after every 5seconds.

C. Problem: Privacy

In future vehicular ad hoc networks (VANETs) can be expected to make traffic safety and transportation administration and supervision more efficient. By allowing the vehicles exchange their sensed congestion environment varying with other vehicles can be realized. Since the vehicle-generated information include confidential information on the vehicle and its driver, many security concerns are created by such exchanges.

Proposed Solution:

Vehicles in pseudonym or false name based approaches can anonymously authenticate their own vehicular reports. It is maintained by the DSRC standard and this approach is conceptually simple. Each vehicle is required to pre-load a large amount of anonymous certificate to achieve confidentiality, and a trusted authority also requires to maintain, manage and administer them which implies a heavy burden of pseudonym or false name management , is one of the major shortcomings. Some proposals suggest using group signatures to anonymously authenticate traffic reports, to circumvent the intricate pseudonym or false name management. In this approach, each vehicle registers itself to the transportation administration department and obtains a secret token. With this token, the vehicle can authenticate any message and the authenticated message can be verified by any vehicle getting it, for authentication purpose we can use 56 or higher bit key with a secure cryptographic algorithm.

VI. CONCLUSION/EXPECTED RESULTS

VANET are very efficient means of communication among moving vehicles. As an outcome of the significant advances in the wireless technology, vehicles are becoming a part of the global network. It has been founded that various schemes and techniques have been proposed to overcome the challenges in VANET but still various loopholes are remaining in this field and solutions are yet to be discovered. This paper provides an overview dealing with all the issues faced in VANETs. We assume that through the proposed solutions following results could be observed:

- The delay in connection over the VANET will be minimized.
- Packet Dropping in VANET will be minimized.
- The communication between nodes will be secure.
- So the overall performance of the network in terms of throughput will be increased.

VII. FUTURE SCOPE

It is basically a cluster of cars that are in continuous synchronized interaction with each other. Each car is aware of its location and where it is heading. In this interaction the first concern which strikes to mind is road safety. If all cars are aware of other cars with all their information collision can be controlled by their respective drivers and can even activate sovereign control to ignore accidents. Not only traffic lights can be linked to the communication network to most competent route traffic in real time but also drivers can be made aware about hindrances to their end point. This constructs a system where the road network always provides the present requirements of the users or clients on the network [6].

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