Parameters Influencing Performance of VANETS

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Abstract—VANETs are subclass systems of MANETs (Mobile Ad-Hoc Networks) in which there is no access point i.e. each node which are high speed moving vehicles receives and forwards the incoming data in the network. The node Density in VANETs is highly dense and frequently variable whereas sparse in MANETS. It is one of the most emerging fields for researchers & industry community. Importance of VANETs may be seen in the context of safety and comfort applications of vehicles moving on the road. These may include Violation Warning, Back up route information, Electronic Brake warning, Collision warning etc. Mobility of nodes changes the network topology as a result of which several parameters are affected cause in loss of throughput & efficiency of VANETS. Moreover, high Velocity of terminals results in the failure of link on the path between source and destination. This paper will show a comprehensive study on important parameters that influence performance of VANETS.

Index Terms—MANETs, Parameters, Path Span, VANETS.

I. INTRODUCTION

From the last decade, the demand of the wireless technology is on high. As the demand is on high, the development of the wireless technology is also rise to research on the networks, which are self-organizing and can be set up at any remote place without the use of any pre-defined infrastructure around it. A network that comprised of a group of mobile nodes, which have the capability of self-organization in a decentralized fashion without fixed infrastructure is called Mobile Ad Hoc Networks (MANETs). Vehicular ad hoc networks (VANETs) are special types of mobile ad hoc networks (MANETs), where vehicles with wireless equipments form a network while moving along a road [1]. Vehicular Ad Hoc Networks is one of the most emerging fields for researchers and industry communities. The rapid change in the topology is the big problem for routing protocol in VANETS. As we know, routing is the process of finding the optimal path between source and destination node and then sending message in a timed Manner. The Route between source and destination can be of single hop (direct) or multi hops (intermediate) in ad hoc multi-hop network. The knowledge of relative position of nodes is very useful in delivering the message from one node to other nodes because there will be a frequent failure in the link when one high speed moving node moves very far from other node. So performance analysis of VANETs can be measured upon the time till which an active route stays.

II. VANET COMMUNICATION

In VANETs, nodes are depends on each other for the communication. Vehicles communicate directly to other vehicles. When any node is not available within the transmission range of the source node for the communication, road side units are provided for such cases[2]. The communication is done with two strategies i) Vehicle-to-vehicle (V2V) ii) Vehicle-to-Roadside (V2R).

A. VEHICLE-TO-VEHICLE (V2V) COMMUNICATION

V2V communication is the base of the VANETs. It is purely the ad hoc network between two vehicles. V2V communication can be of direct link or multi-hop route. When the destination node is present within the transmission range of the source node then the direct link communication is occurred. If destination node is present outside the source node then intermediate nodes are used to deliver the information up to destination node. The intermediate nodes are also moving vehicles, but within the transmission range of the source node. These are also called single-hop and multi-hop packet forwarding techniques.

![Figure 1. V2V Communication](image)

The V2V communication is mainly used for the safety applications like Road blockade alarm, Electronic brake warning, Oncoming traffic warning, Vehicle stability warning, Lane change warning, collision warning etc. This communication is also used for the different types of the protocol operations and calculation. To set up road side units like fixed infrastructure access points, internet gateways, base station etc. on the road side would be very expensive. That’s why; VANETs should use V2V communication as much as possible, for communication purposes.
B. Vehicle-to-Roadside (V2R) Communication

V2R communication is the combination ad-hoc network and fixed infrastructure networks. V2R communication (in figure 2) involved vehicles and road side units. The communication is only single hop communication between vehicle and road side units. Vehicle sends the message to the road side unit and it sends a broadcast message to all the vehicles in the neighborhood. Road side units use higher bandwidth link for the communication. These units transmit the periodic broadcast messages to all the vehicles containing speed limits and other information. These units may be placed at every one kilometer or less, enabling high data rate to be maintained in highly dense network traffic.

Figure 2. V2R Communication

A. VANETS APPLICATION

VANETs are developed for the safety of the human life, but as the technology developed, some comfort features are added into it. The application of the VANETs can be classified into two categories i) Safety Application and ii) Comfort Application. Some specific applications are very crucial for the safety of the human beings. The application of the VANET in real world network can be explained as follow.

1. Intersection Collision Avoidance

The intersection collision application is come under the safety application as it is critical for the safety of the driver and passengers. Some of the applications under this category are as follows: Traffic Signal Violation Warning, Stop Sign Violation Warning, Left Turn Assistant, Stop Sign Movement Assistance, Intersection Collision Warning, Blind Merge Warning and Pedestrian Crossing Information at Designated Intersections.

2. Public Safety

Public safety is the application where VANET warns about the public vehicle, which should be allow to pass on and also informed about any accident happens on the road with the help of the VANET communication. Approaching Emergency Vehicle Warning, Emergency Vehicle Signal Pre-emption, SOS Services, Post-Crash Warning etc. are come under public safety applications.

3. Sign Extension

We all know that most of the road accidents are occurs because of the traffic rule violation. VANET also help to decrease the violation of traffic rules on the road by using sign extension application. The violation of traffic rules are not allowed in vehicles. In-Vehicle Signage, Curve Speed Warning, Low Parking Structure Warning, Wrong Way Driver Warning, Low bridge Warning, Work Zone Warning, In-Vehicle Amber Alert etc.

4. Information from Other Vehicles

VANET is all about the communication between vehicles on roads for the safety of the passenger and driver. The information exchanges between vehicles are crucial and important for the security of human life. The applications based on V2V communication are as follows:- Cooperative Forward Collision Warning, Vehicle-Based Road Condition Warning, Emergency Electronic Brake Lights, Lane Change Warning, Blind Spot Warning, Highway Merge Assistant, Visibility Enhancer, Cooperative Collision Warning, Cooperative Vehicle-Highway Automation System (Platoon), Cooperative Adaptive Cruise Control, Road Condition Warning, Pre-Crash Sensing, Highway/Rail Collision Warning, Vehicle-To-Vehicle Road Feature Notification etc.

III. RELATED WORK

Over the last Decade number of research work have been proposed to develop the efficient and reliable Vehicular ad hoc Network. High mobility of the vehicles, frequent change in the network topology, road layout, different traffic scenarios such as highway and city are the characteristics of VANETs[3]. These characteristics make the development and the research work challenging in this network. The path span of the routes is mainly depends on the routing protocols design and algorithm. The mobility of the nodes is tackle by the procedure of the routing protocols. The estimation of the path span is depends on the knowledge of the entire network topology that changes frequently due to high mobility of the vehicles [4]. Therefore, the estimation of the path span in the VANETs can reduce the communication and the route maintenance overhead.

A. Parameters affecting Performance of VANETs

In VANETs the main concern is mobility of the nodes. As the mobility changes, there is dynamic change in the connected graph or nodes and in network topology, which affects the performance of network. If a node wants to send data which is too large to its neighbor, the link should be active till the communication is completed[5]. If neighbor node move away from the node before communication is completed, a premature disconnection will happens and receiving node will not get the data in full. The failure of path increases the overhead of the routing protocol and affects the throughput of the network as well. As soon as, a path failure occurs, routing protocol has to form new path for communication. Path span is actually the minimum link span along the path. Path span can also help to assign the TTL (time to live) for the routing protocol. To minimize the frequent path failure occurs, the calculation or estimation of path span should be done. Due to
this frequent path failure the performance and throughput of the network are degrading.

Estimation of path span in VANETs is very difficult task as it depends on the different factors of the ad hoc networks. There are some parameters defined which affect the path span in VANETs i.e. Node density, transmission range, number of hops, velocity of nodes, and routing protocols are some of these factors. Therefore, the estimation of the path span for a particular route will provide the information and help to choose a suitable path for the transmission.

1. **Path Span Estimation in VANETs**

Numerous theoretical and mathematical works related to the estimation of the parameters that influence performance has been done.

Projection of the path span in the MANETs is challenging task. In VANETs, when the speed of nodes is very high, the evaluation of path span becomes very difficult. In MANET, it is vital to send data from source to destination by using intermediate node. Greedy forwarding is also known as least remaining distance (LRD) that attempts to minimize the remaining distance to the destination with each hop. In the average distance and progress per hop gradually varies with respect to current distance to the destination node and is a function of node density. The end to end delay with the help of per hop trans-receive latency.

In [6], a link reliability model proposed for vehicle ad hoc network. Here, the link reliability model are classified in two type (i) Link lifetime estimation based algorithm in which each link lifetime distribution of path is estimated as a routing metric (ii) prediction basic link reliability estimation algorithm takes on the probability link distribution model in the route formation process. In this paper, the novel link reliability model is developed. I this model, only microscopic details of node movement pattern is used in the form of node density average speed and traffic flow. The result shows that link reliability is one of the most critical factors of the VANETs performance.

2. **Analysis of Path Span in VANETs**

Path span is primarily based on the path selection as only after selecting a path, other parameters comes into the scenario of estimation. Therefore, the path selection is also an important aspect in VANETs. Path selection should be done, so that the distance between the source and destination should be minimum. However, a scheme to explore long path is not the best path when path span is taken into account. The path span of the route is also critically essential as a path breakage affects the communication in the mid of the transmission. A new route or path has to be set up for the further communication once the path failure happen [7]. It degrades the performance of the ad hoc networks, as new route requires time and overhead both. To increase the efficiency and performance of the VANETs, knowledge of the path span can help greatly. The path span is also not an independent factor as it also depends on the various other factors. The parameters, which related to the path span, are examined under different models and protocols.

3. **Path Span under Different Situation**

Our focal point is on the study of the path span in the VANETs. The path span is an important design parameter for the better performance and routing protocol in VANETs. Author in [8], shows the analysis of path span and provide different parameters related and dependent on the path span in MANETs. Authors also present the path span impact on the reactive routing protocols. The result shows that the path span Probability Density Function (pdf) for large number of hops can be estimated with the help of exponential distribution. The exponential distribution is depends on the different parameters like relative speed of the mobility model, transmission range of nodes and number of hops. This result helps to enhance the performance of the reactive routing protocols used in the MANETs. It also shows that the inverse of the path span is directly proportional to the throughput of the ad hoc networks for dynamic Source Routing (DSR) protocol.

To maximize the path span of the nodes, each link span of that path must be maximum. If there is any link breaks in the route, it means whole route will be expire. The link stability and route lifetime are directly proportional to each other. In [9], link stability and route lifetime are analyzed for the ad hoc networks. “Edge Effect” phenomenon occurs in the highly dense networks is also discussed. “Edge Effect” phenomenon is an adverse effect on the network performance when the greedy routing approach is used in done networks. In greedy routing approach sensor node selects the border node or node cover maximum distance towards the destination. In the dense network, nodes are easily available at border of the transmission range and selected as the next-hop node for further transmissions. Small movement of the border nodes outside the transmission range breaks the path and degrades the performance of the network. Therefore border node must lies within the transmission range or on the border line of the sender’s transmission range to improve the routing as well as overall network performance.

Path selection is important to decide the path span of the route in ad hoc networks. The shortest path is not always the best in terms of the path span.

IV. **Conclusion**

The work has been carried out in this paper to contribute for the improvement of the performance of the vehicular ad-hoc
networks. This work will help to enhance the throughput and path span of the routes. But we know, a research work cannot be completed perfectly, as always there is a scope of enhancement. Ability to maintain a consistent route on a network is a very useful parameter for increasing throughput and performance of vehicular ad-hoc network. In VANET, in order to maximize the communication link between nodes, it is very necessary to maintain the path duration. Therefore, message can be send timely to reduce the large number of accidents on the road. Analytical estimation of average path duration helps us to improve the routing performance and decreases the number of path failures occurs in VANETs.

REFERENCES

3) V. Lenders, J. Wagner, and M. May, (2006) “Analyzing the Impact of Mobility in Ad Hoc Networks”ACM, Conference in Florence, Italy

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