Effective Gateway Selection Algorithm to Improve the Quality of Service of Vehicular Adhoc Network

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***Abstract*-Vehicular Ad Hoc Networks (VANETs) is a kind of special type of wireless ad hoc network, which has the characteristics of high node mobility and fast topology changes. Vehicles can communicate with each other is called Car to Car communication (C2C). Vehicles communicate with fixed equipment next to the road referred as Road Side Unit (RSU) and Car to Infrastructure Communication referred as C2I. The Vehicular Networks can provide wide variety of services, range from safety-related warning messages to improve the navigation mechanisms as well as information and entertainment applications. VANET will allow the vehicles to communicate through gateway which should be efficient. This paper deals with the selection of efficient gateways in the highway environment and the result is analysed in the Network Simulator (NS2) to study the Quality of Service of the network in VANET.**

Keywords—VANET,QoS, Gateway,Efficient Gateway Selection

I. INTRODUCTION

In VANET Vehicular sensor nodes are carried the signals to make communication among the vehicles. The sensor readings are to be sent to the base stations (BS) via Road Side Sensors (RSS) nodes. These nodes can communicate with each other (or the roadside sensor) via Dedicated Short-Range Communication (DSRC). The communicating/computing devices in vehicles (On Board Unit-OBU) are also come under vehicular ad hoc network. Once a vehicle is processed the sensor data, it may interpret the data as a dangerous situation and trigger a safety warning message to nearby vehicles through vehicular ID. For this message, the vehicle determines a geographical region defined by a geometric shape and broadcasts the Hello message to its neighbour vehicles. The communication system of the vehicles ensures that the data packet is reliably distributed to all vehicles located within a region. As a result, vehicles that receive the information are warned about dangerous spots ahead of time and can take appropriate corrective measures. If the vehicle is connected to Internet which will provide vast opportunities for applications to make the drivers' driving experience more enjoyable. To interface the VANET's internet access with vehicles deployed along with the roadsides we need the Gateway.

Gateway is used to make the communication between the vehicles and infrastructure for sharing data from nearby vehicles. In the transportation system each vehicle will act as a communication center to send/receive/broadcast data or information to VANET about the safety. Hence, vehicles must be equipped with radio interface or OBU that enables dedicated short range wireless networks.

Gateways are periodically broadcasts Hello message with TTL and request ID. Client vehicle sends a request to connect message to its related gateway. The connection from the client vehicle through the gateway is thus built. Thus gateway selection is an important element to integrate both the networks. The gateway sends Hello message itself in order to discovered by neighborhood nodes, reply by "yes" and enable the nodes to stay connected during handoff from one gate to another.

VANET supports real time information propagation (public safety and other message flows) by enabling efficient communications between vehicles to infrastructure. To improve the overall performance of QoS of the network, it is necessary to select efficient gateway with stable path. In this paper, we proposed a method of identifying an efficient gateway of the network by using the parameters such as strength of the signal, link transmission rate, residual energy, path latency, and time of expiry explained in chapter 3. In chapter 2 we explained the literature survey of the related work, chapter 3deals the proposed model, chapter 4 provides the result and discussion and in chapter 5 Conclusion and Future work is discussed.

II. LITERATURE SURVEY

Amadou adama ba et al (2011) proposed the protocol called DRIVE. The authors developed a Service Discovery Protocol, which is highly optimized for the characteristics of future vehicular ad hoc networks. The advantages of DRIVE is that the Efficient and scalable solution for the discovery of internet gateway in such a highly mobile vehicular environment and Intelligent fuzzy system for deciding which gateway currently fits best according to requirements of the vehicle. The major advantage of the paper is to determine the better route between the vehicle and the gateway.

Hemalatha R et al (2013) proposed that the communication between the infrastructure network and the MANET is provided by some MANET nodes called gateway nodes that are equipped with multiple interfaces. The authors made comparison of different gateway algorithms (C2N, C3N and C4N) among which C4N has highest packet delivery ratio, reduced the bandwidth consumption, and try to improve the throughput and reduce the data loss and errors.

Safdar Hussain Bouk et al (2012) proposed a gateway selection scheme that considers multiple QoS path parameters to select a potential gateway node. To improve the overall network performance, it is necessary to select a gateway with stable path, a path with the maximum residual load capacity and the minimum latency. To improve the path availability computation accuracy, the author introduces a feedback system to updated path dynamics to the traffic source node and proposed an efficient method to propagate QoS parameters in our scheme. Computer simulations show that our gateway selection scheme improves throughput and packet delivery ratio with less per node energy consumption. It also improves the end-to-end delay and network performance compared to single QoS path parameter gateway selection schemes.

Amit Kumar Gupta et al (2014) proposed that the path established with the RSU is secure as the path may include quite a few malicious nodes or even congested nodes that may drop the packets it receives without forwarding. To overcome the situation and offered a host-to-host security, it is important to select a trusted secure gateway and authenticate it, which can be reached via trusted and traffic less route and trusted node. Protocol used here is Extensible Authentication Protocol (EAP).By using EAP, a user requests connection to a wireless network through an access point (a station that transmits and receives data, sometimes known as a transceiver). The EAP contain an authentication server that validates the node information. Some of the advantages of using EAP protocol is that the Data transferred in the efficient trusted route. Data transmissions are performed through the authenticated secGW. It permits centralized management of authentication.

Divya AS et al (2015) proposed a Gateway selection schemes have been proposed to selects gateway nodes based on some parameters. If the traffic source node is moved on another gateway transmission range, then it transfers the traffic on that path via another gateway. To improve the overall network performance of the network, it is essential to select a gateway with stable path. The proposed work shows the performance metrics of QoS of the network like Energy Efficient level, Residual Energy level, and Delivery Ratio are measured and compared with existing Location-Aided and Prompt Gateway Discovery algorithm.

The literature survey shows various selection of efficient routing protocols, Quality of Service of the network (end to end delay, packet delivery ratio, multi hop routing, to reduce the communication overload, efficient trusted route), gateway selection mechanisms. Over there the authors did not specify about the handoff selection and determines the efficient gateway selection. The following chapter explains the proposed work related that how to determine the efficient gateway selection to access the internet.

III. PROPOSED WORK

In the proposed work, the node (vehicles) establishes a gateway with the parameters like strength of the signal, availability of the path load with residual energy and time delay. To develop an algorithm, first of all determine the Efficient Gateway Selection for accessing the internet through VANET. Next it is identified the probability of the existence of a network, where the network path consists of path of latency and link expiration time, etc. Based on the literature survey, no such work has considered the existence of network paths among the vehicles and the establishment of gateways.

In the proposed work Efficient Gateway Selection algorithm, each node is provided with an ID and the details are maintained in the routing table. The internet gateways are deployed in the Road Side Unit (RSU) and sent the "hello" message which includes traffic information along with, in which access point the packets to be delivered through wireless network at equal interval to the nearby vehicles. Based on the strength of the signal, link transmission rate, residual energy, path latency, and time of expiry in the highway scenario Efficient Gateway Node will be selected for a particular transmission range. Suppose, more than one gateway is reachable, Efficient Gateway Selection will be adopted based on the residual energy and minimum time delay. If the node (vehicles) moved from the one transmission range to another then the nodes forms a path to reach a gateway through multi hop communication. If the node is within the transmission range it communicates directly.

A. Strength of the Signal

In vehicular ad hoc network, vehicles are connected Peer 2 Peer mode and the signal strength between them are important of the accuracy and transmission rate. The strength of the signal between vehicles the closure the vehicles are and smaller their speed difference is the stronger their signal. Therefore, we mainly consider the distance and speed difference to the strength of the signal. It is defined as

$$SS = w1 * \left(1 - \frac{\partial t}{\partial t_{\max}}\right) + w2 * \left(1 - \frac{\partial s}{tr_{\min}}\right) \text{--------(1)}$$

Where SS is the strength of the signal, w1 * w2(we assumes w1,w2=0.5) are the weight factors, ∂t is the current speed difference of two nodes, $\partial t_{\max}$ is the maximum speed difference, ∂s is the current distance of the nodes v1 and v2 and tr_{min} is the minimum transmission range(250m).

B. Link Transmission Rate

In VANET each node send hello message frequently and we use the hello packet to measure the link transmission rate. Link transmission rate is calculated by

$$r(t) = \begin{cases} count\,(t_0, t), \quad 0<t-t_0<1 \text{--- (a)} \\ \dfrac{count(t_0 - t)}{t_0 - t}, \; 1<=t-t_0<w \text{--- (b)} \\ \dfrac{count(t-w,t)}{w/r}, t - t_0 >= w \text{ --- (c)} \end{cases} \text{---(2)}$$

r- broadcast interval of the hello message, count(t_0, t) is the number of hello packets received during (t_0, t) and w is the window, (a)0<t-t_0<1(the packet delivery rate is the no. hello packets received from(t_0, t)), (b)the packet delivery probability is the no. hello packets received from(t_0 to t divided by the length of this period ad (c) t-t_0>=w is $1/d_f$ x d_r(packet delivery rate).

C. Residual energy

In VANET, the nodes usually depend on their energy (battery power). When prolonging the networks' lifetime energy consumption is more. Therefore, the residual energy is to be calculated periodically.

$$E_r = \frac{(E_{int}(n) - E_{res}(n))}{E_{int}} \quad \text{-----------(3)}$$

Where E_r is Residual Energy, E_{int} is the initial energy of the node, E_{res} is the remaining energy of the node and n is the number of nodes.

D. Path latency:

Path latency is defined as the addition of propagation delay and processing time of a packet from one node to another node. Latency can either be hiked when the packet is relayed in a hop-by-hop fashion from sender to the receiver node or when the congest load is high on any node in the path. Latency of path i, Yi, is the additive measurement of latency at each link on the path between the gateway and mobile node.

$$\delta i = (Li/L\max) + (Ci/C\max) + (Y\min/Yi) \quad \text{--(4)}$$

Based on the above given formula strength of the signal, link transmission rate, residual energy, path latency, and time of expiry in the highway scenario efficient gateway node will be selected for a particular transmission range. Next the QoS of the network such as Delivery Ratio, Efficient level, and Residual Energy has been analyzed and compared with Location-Aided and Prompt Gateway Discovery (LAPGD). Location-Aided and Prompt Gateway Discovery Mechanism proposed by Kejianju 2014. In which every vehicle is equipped with UMTS Terrestrial radio access network and the status of the gateways are recorded in its gateway table. While compare to other gateway selection algorithm LAPGD electing good gateway nodes according to the key metrics like vehicle velocity, inter vehicular distance in efficient manner.

IV. RESULT AND DISCUSSION

The entire work has been implemented and tested in NS2. The VANET simulations set up is as follows.

TABLE 1: PARAMETERS USED IN THE PROPOSED WORK

Parameter	Values
Channel Type	Channel/Wireless Channel
Radio-Propagation Model	Propagation/Two Ray Ground
Network Interface Type	Phy/Wireless Phy
MAC type	Mac/802_11
Interface Queue Type	Queue/Drop Tail/ PriQueue
Link Layer Type	LL
Antenna Model	Antenna/Omni Antenna
Max Packet In Ifq	50
Routing protocol	AODV
No. of nodes	50 to 300

Figure. 1 shows calculation result of trace file (path availability, load and capacity).

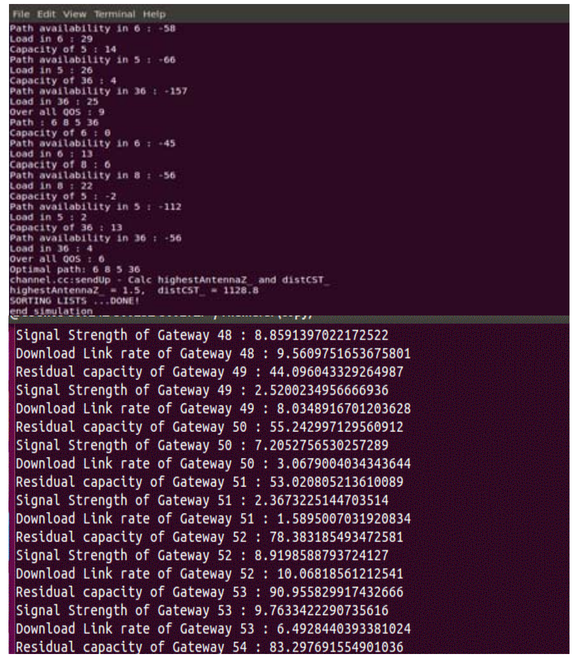

Figure. 1 Sample Trace File of the Proposed Work

Figure. 2 represents the Network Animation (NAM) result. It shows the communication between the vehicles for efficient gateway selection. In our result vehicle 4 gets the data from 35, vehicle 5 gets data from 32, and so on. Green color indicates the efficient gateway. Circles represent the range of the infrastructure network.

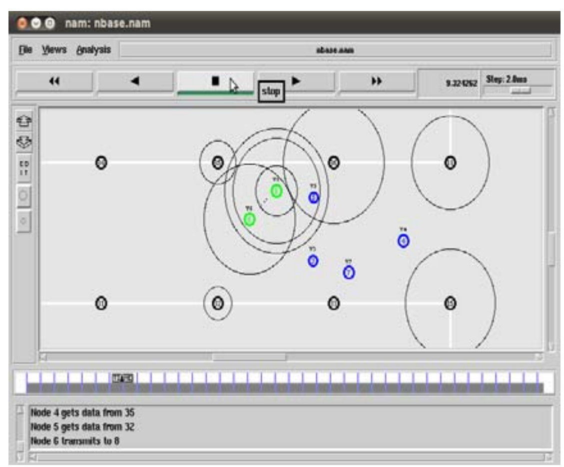

Figure.2 Sample NAM file for the proposed work

The result has been compared with Location-Aided and Prompt Gateway Discovery (LAPGD) algorithm, while comparing the efficient level our algorithm (Efficient Gateway

Selection algorithm) provides better result as shown in figure 3.

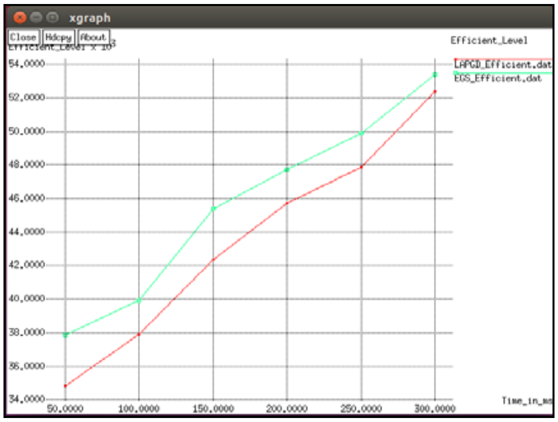

Figure.3 Comparison of Energy Efficient Level

During the gateway selection the energy consumption of the nodes should be reduced, even the number of nodes increase from 50 to 300. The energy consumption can be saved by utilising residual energy. Our result shows the utilisation of residual energy is high while comparing the existing algorithm as shown in figure 4.

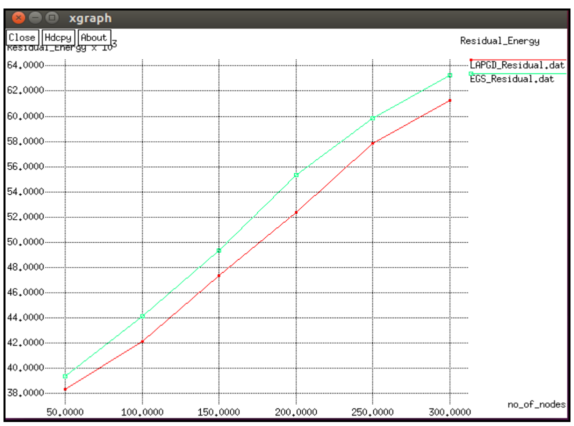

Figure. 4. Comparison of Reidual Energy level

One of the important parameter in the QoS is packet delivery ratio. In our work the delivery ratio has been improved as shown in figure. 5.

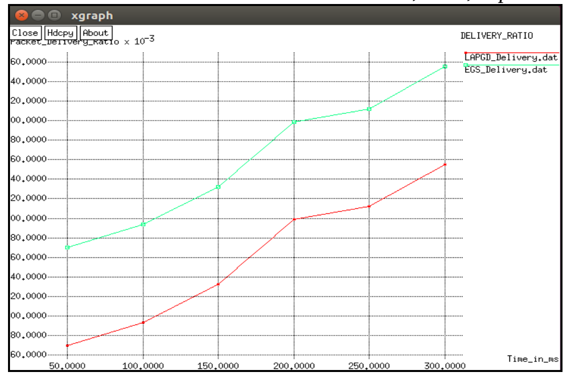

Figure. 5. Comparison of Delivery Ratio

V. CONCLUSION

The proposed work has been done for a highway to improve the QoS of the network. While the vehicles are in movement the communication between the vehicles are tedious. So, it was proposed to select a node for communication to nearby vehicles called a gateway node. Since, the communications are through wireless network (VANET) the efficient node should be identified. In our work the efficient gateway node is selected by using the parameters strength of the signal, availability of the path load with residual energy and time delay. The work has been implemented to test the QoS of the network and compared the result with the existing system. Finally, we achieved the result.

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