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Cross Layer Design Method for Efficient Data Delivery in VANET for City Scenarios

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Abstract
Vehicular Ad-hoc Networks plays the vital role in wireless communication networks. It provide safety, security and most probably provides the entertainment as well. The performance of this wireless communication depends upon the how better routing decisions takes place in the network. The routing of data determine by the routing protocols being used in the communication and depends on different scenarios i.e. the city and the highway. OLSR (optimized link state routing protocol) is used to provide best QOS under very low and high density of vehicles. Hence OLSR is used to find the best route in all kind of density environment in city scenario. NS 3 simulator is used to validate the cross layer routing on IEEE 802.11p by comparing in terms of packet delivery ratio (PDR), throughput and overhead for the protocols: Ad-hoc On-Demand Distance Vector routing (AODV) and Open Link State Routing (OLSR) protocol.

Keywords: *PDR, AODV, OLSR, IEEE 802.11p, VANET*

1. Introduction

Intelligent Transportation Systems (ITS) provides the smart transportation system for the user which has more attention nowadays over the world. More people are working on it like automotive companies, industrial research communities and ITS designers to provide the fruitful solution the public. The main aim is to develop protocols and standards of ITS due to increase in number of vehicles for the safety transportation systems. Developing the Mobile Ad-hoc Networks (MANET) for vehicle applications led to the existence of VANET. The core of 'ad-hoc network' is to form an mobile vehicle with ever-present connectivity. Every vehicle should act like a moving node and also it moves along with the prearranged ways. Then the connectivity is setup when a vehicle tries to search for the nearest vehicle or setup within the whole communication network. Since vehicles can communicate with each other. It provides assistance for driver, traffic efficiency, and safety, security to both driver and passengers with a variety of applications to be added in evergreen automobile designs.

AODV is the reactive routing protocol used in VANETS. AODV is the one of the type of Distance Vector Routing protocol (DVR). In AODV every node sustain a table for update the routing information. Every routing table entry have the source address, destination address along with the information of the next hop, number of hops, destination sequence number, active neighbor for this route, and the expiration time is present.

OLSR is one of the top level protocol which is also called as proactive routing protocol in VANET. It can also be mentioned as an autonomous network, which have multiple sensor nodes, which are mobile in nature. The main key issue in VANET is routing. Since the nodes are mobile in nature, so it is not easy to have a fixed topology. This paper represents an optimization technique to tune the parameters of OLSR protocol for different routing operations. For large number of nodes in a network OLSR protocol is opt. In a Link State Routing protocol (LSR), the links which is combine with its neighboring nodes are acknowledged and these are overflowed automatically into the entire network. By this optimization technique some beneficial factors like reduces the size of control packets is provided, instead of link the all packets as well as declares only its subset of links with its neighbours Known node as its multipoint relay selectors.

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2. Existing Method

In[1] the author proposed cross layer design with IEEE 802.11p.In this method combining two ray propagation and log normal shadowing propagation model. The performance of this method is in terms of PDR (Packet Delivery Ratio). It results unstable performance in general. In normal situation the PDR value is decreased by increasing the number of nodes. The PDR value further decreases when the number of nodes more than 70 due to link failure. There is an improvement in PDR when number of nodes reaches 130 due to stable routing path. The highest value of PDR is 99.42% achieved when the number of vehicles was 200. Due to traffic congestion in city area the range of PDR is decreased which can be seen clearly. This is done by in MATLAB.

In conventional and traditional networks, channel modeling has shows the significant impact on the performance of routing design protocol [9,10]. To show the limitation in realistic VANET network, unit-disk and Log-Normal models was presented in [12]. In this paper, for four different highways by using real time data to show the suitability a method is used to change the parameter of distribution in Log-Normal model with respect to the number of vehicles. The new technique is proposed based on IEEE 802.11p which is called Cross layer design (CLD) aims to decrease delay and improve both the throughput and PDR [6]. For multimedia applications, to take care of uncertainty in other routes Enhanced version of AODV (En-AODV) work was done recently by the author in [3]. Vehicle calculate the more stable route by data's of CLD and final destination In order to determine the stable and trustable route two additional information has been added to Route Request (RREQ) which reduces communication overhead where the key factor is minimum lifetime and destination region is proposed. Network Simulator 3 is used to enlighten efficiency and its status by comparing with the AODV under the different parameters and highway or city scenarios.

In [13] the recent work on CLD communication solutions is presented. Many approach is introduced and followed by the survey of corresponding CLD protocols. Finally, open research is developed for the efficient CLD protocols for the next generation transportation systems in the wireless communication environment. Authors in [4] determine the 802.11p MAC protocol with different densities (0.01-0.5 vehicles/m) of vehicle. The MAC protocol is determined with respect with the parameters of collision, reliability, delay and throughput in the OMNeT++ simulator. This shows that MAC protocol can be better by expanding the Control Channel interval (CCH) and proves that this can persuade the delay necessity in the VANET for the safety applications.

Authors in [7] analyze the simulation results to examine the behavior of MAC of CSMA vehicular communication the fruitful solution shows several contempt for high vehicular density, both for an individual nodes and for the entire system. This shows that MAC is not appropriate for a messages over a periodic locations. Loss rate, bit rate, jitter, and delay were analyzed in paper [15] for IEEE 802.11p devices by using UDP protocol. It gives better result in VANET scenario. To achieve accepted performance gains CLD has been coined in recent works and dependency between layers of the protocol is executed which is a summary from the latest related works. IEEE802.11 is enhanced as IEEE802.11p which open hands to ITS applications where the reliability and low latency are important factors. The actual radio propagation models such as shadowing model etc., are considered for evaluation for cross layer design (CLD) in IEEE 802.11p.

3. Proposed Work

3.1 Two-Ray Propagation Model

There is no existence of line of sight between sender and receiver at all the times. For research work non line of sight (NLOS) can be taken into consideration [5]. In this paper, few variations have been explained for different fundamentals. $P_r$can be estimated based on cross over distance by taking into account the propagation model from the following equation:

$$d_{cross} = 4\pi h_{tx}h_{rx}/\lambda \quad (1)$$

Where: h_{tx}= height of the transmitter antenna, h_{rx} = height of the receiver antenna and λ = wavelength of the signal. The bonding between the grade of received power (P_r) and the distance between two communicating nodes (d) lieon the value of $d_{cross}$is given by the equation

$$P_r = P_tGrxGtx\lambda 2/(4\pi D)^2 \quad ,D<d_{cross} \quad (2)$$

$$P_r = P_tG_{rx}G_{tx}4\pi h_{tx}^2h_{rx}^2/\lambda^4 \quad ,D>_{dcross} \quad (3)$$

3.2 Nakagami fading model

The Nakagami-m fast fading model, is utilize for the variations which present in the signal due to the presence of multipath fading. It does not have the path loss because of the distance traveled by the signal, hence for the average simulation usage it is recommended as in a combination with other models. The probability density function is defined as

$$P(x;m\omega) = \frac{2m^m}{\Gamma(m)\omega^m}x^{2m-1}\, e^{-mx2/\omega} \quad (4)$$

With the parameter of fading depth and the average received power. It has been used to model attenuation of wireless signals traversing multiple paths. It is most suitable for evaluating the VANETs protocols over city scenarios.

3.3 Routing Protocol

Routing table is not build by an AODV node in advance whereas it is formed when there is a need to transmit a packet. Dynamic Source Routing Protocol and Distance Vector Routing Protocol pitfall is overcome by AODV i.e. The process of maintaining the routing table by Dynamic Source Routing between the sender and receiver becomes slow. AODV reduces the flow in the communication and provides low overhead comparing to the other proactive protocols when the network is large

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which is very difficult to main the routes which automatically increases the overhead of the packet. Whenever the node is available to send the data to the other needed nodes by establish a distant route in the network It minimizes the size of required memory. Instead of keeping the whole information the table provides the information like the recently active nodes and the next hop node present in the router. AODV uses destination sequence numbers for route discovery which eliminates looping in routes and provides dynamic updates for adapting the different route conditions. AODV is more suitable for large area networks and network which having the high dynamic topology. This protocol causes more delay in route discovery process. When route failures occur, then the new route discovery is needed for causing additional delays it results in decreasing the data transmission rate and increasing the network traffic. It leads to more bandwidth consumption. is increased due to increasing If the number of nodes is increasing then the bandwidth consumption is also increases in the network. It leads to collision and occurrence of packet loss in the router.

OLSR is based on link state protocol and proactive in nature. This protocol inherits the property and feature of LSR algorithm. It is easy to have the routes shortly whenever it is needed. It supports a mobility node so that it can be easily drawn through its LC data, it depends on the frequency of these broadcast datas. We have chosen this protocol because its provide numbers of features which is suitable for highly dynamic networks. Using OLSR, we can know immediately know the status of link. It can easily integrated with the existing operating systems and devices.

Second advantage is that to minimizes the flooding of the traffic control with the help of the selected nodes, such as multipoint relays (MPR), it diffuse its messages inthe network. Only the MPR have ability to retransmit its broadcast messages. These techniques significantly help-full to minimize the retransmissions in a flow or broadcasting procedure. Multipoint Relays of node in which every node periodically deliver the information, which contains the information about its neighbors node and the link status. Generally this type of data are sended like broadcast, further which are collected by all (N) neighbors. It contain the list of addresses of the neighbors. In Neighbor table, every node stores the information about its N, also store the status with this N, and a series of two-hop N2, these N give access to the N2. The link may either in any form like unidirectional, bi-directional or MPR.

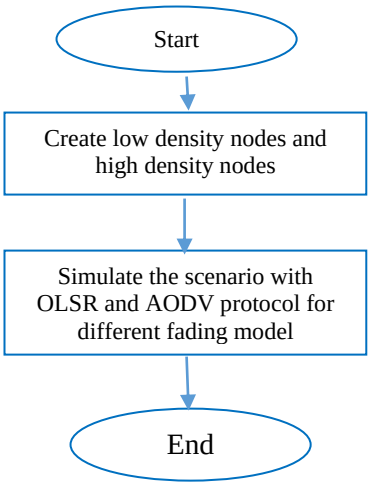

Figure 1: Flow chat of the proposed work

If want to build the intra-forwarding then there is a need a database for routing packets, in which every node broadcasts specific control messages which is known as Topology Control (TC) messages. These TC are conveyed like other messages into the whole communication. It sents periodically to every node to declare its MPR Selector set which present in the network, i.e., it contain the message with list of neighbors who have selected the sender node MPR. The table is built from the gathered data by tracing these pair by connecting in the descending order. Every nodes in the whole network maintains its own table, in which it store the data about the network which is obtained from the TC. The flowchart of the proposed work is illustrated in figure 1.

4. The simulation parameters

Table I: The simulation parameters

Simulation parameter	Typical values
Frequency	5.9 GHZ
No of vehicles	100
G_t	10
G_r	10
H_t	1m
H_r	1m
Physical layer	IEEE 802.11p
Channel type	wireless
Propagation model	Two ray and nakagami propagation model
Protocols Employed	OLSR
Simulator	NS-version 3 simulator
Simulation time	300s

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5. Result and Discussion

5.1 Packet Delivery Ratio

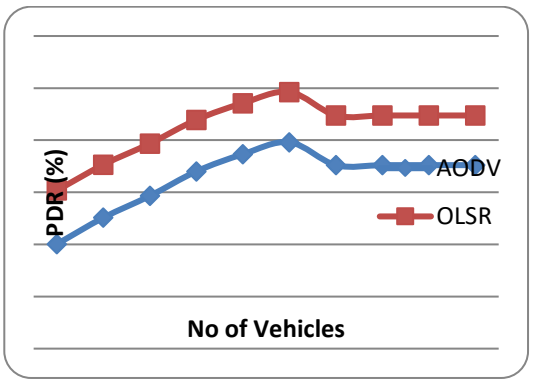

Figure 2: PDR of OLSR vs AODV

$$PDR = \frac{\text{Number of packets received by the receiver}}{\text{Number of packets send by the sender}}$$

The Figure 2 shows that the packet delivery ratio is very high in OLSR when compared to the AODV routing protocol.

5.2 Throughput

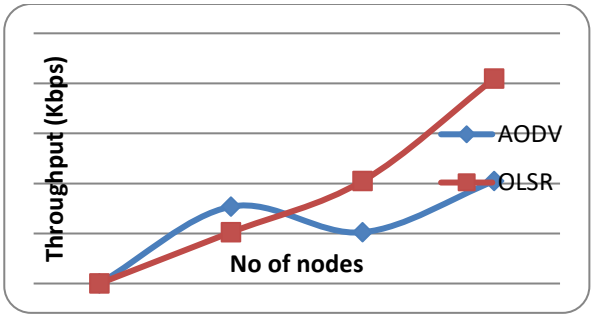

Figure 3: Throughput of OLSR vs AODV

Throughput is the rate of successful message delivered over a communication channel. The Figure.3 shows that throughput of the OLSR is when compared to the AODV.

5.3 Overhead

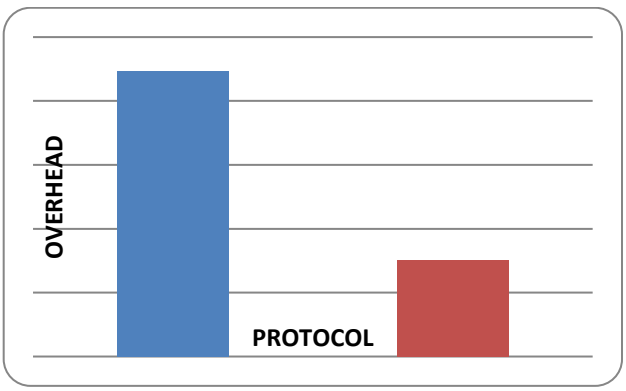

Figure 4: Overhead of OLSR vs AODV

Overhead is the number of packet size increases, then the congestion will occur. The Fig.4 shows that the overhead of the OLSR low when compared to the AODV.

6. Conclusion & Future Work

There are some many issues in VANET nowadays, people who are working in this field showing interest to find the solutions for critical issues. One among them is our work which has an aim to determine the performance of the AODV and OLSR routing protocol for IEEE802.11p in cross layer design approach. The output is compared for minimum overhead, PDR and average throughput which got through simulation. The upcoming work can be to determine the performance of cross layer design in high density of vehicle in city scenario for different propagation model and fading models. The obtained results gives the better performance when compared to the existing method.

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