Performance Analysis of Routing Protocol to Improve Qos in Vanet Environment

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***Abstract*— Vehicular Ad hoc Network (VANET) is a new communication system that enables the communication between vehicles on the road network which may divide into two categories. 1) Vehicle to vehicle (V2V) and vehicle to infrastructure (V2I). They are several approaches of data transmission in vehicular network are used to inform vehicles about dynamic road traffic condition for achieving safe and efficient transportation system. VANET provide inherent characteristic such as unpredictable node density, fast movement of vehicles, constraint mobility make data transmission quite challenging and general purpose ad hoc network routing protocols cannot work efficiently with it. In this paper we propose a routing protocol OFDM based AODV that ensure that throughput and Packet Delivery Ratio (PDR) efficiently and to improve the network resources and better utilization of network performance.**

***Index Terms*— AODV, City scenario, Routing protocol, Vehicular Ad hoc Network (VANET).**

I. INTRODUCTION

Vehicular ad hoc network are created by applying the principle of mobile ad hoc network (MANET) a spontaneous creation of wireless network for data exchange to the domain of vehicles. VANET were first mentioned in 2001 under car-car ad hoc mobile communication and networking application were network can be formed and communication can be relayed among the cars. VANET is considerably attention from research community and automotive industry to improve the service of intelligent transportation service. VANETs have characteristics such as nodes are highly mobile, rapid topology change and highly dependence of neighbor nodes. Therefore, routing protocol of VANETs must be content with these characteristics.

Because of these characteristics many researchers have been proposed channel assign algorithms such as dynamic channel assign according to node density and adaptive channel assign using V2I. However, existing proposed channel assign algorithms assume equal to data packet size.

This assumption could not provide various services for VANETs due to limited data packet size. Therefore, in this paper, we analyzed transmission rate of differences data packet in VANETs environment and proposed future research about improving transmission method according to difference data packet size. QoS suffers from the following factors:

a. Dynamic Location update
b. Environmental Impact over channel
c. Channel Interference
d. Velocity
e. Contention
f. Congestion

II. RELATED WORK

Many algorithms have been proposed to utilize the specific properties of VANETs for routing packets. Algorithms are usually classified according to their communication types to broadcast, geocast, multicast, and unicast categories. In this section, we focus on unicast routing protocols in VANETs. They are divided into proactive and reactive.

R. K. Lam et al. study the behavior of routing protocols in VANETs by using mobility information obtained from a vehicular traffic simulator based on real road maps of Switzerland. Haas et al. investigate the communication requirements for crash avoidance in vehicular networks.

In order to support the above safety requirements, an appropriate Media Access Control (MAC) scheme is needed. Several MAC schemes for VANETs were proposed in the literature. Ray et al. described DCR (dynamic channel reservation), a TDMA scheme which allocates vehicles unique slots in 2-hop radius and thus avoids collisions, and allows fast broadcasting of emergency messages.

In a continuation paper they describe a dynamic scheme for dividing channels between the two opposite lanes. E. M. Royer et al. examine multi-hop emergency message dissemination delay using several dissemination strategies.

Few researchers suggest the MAC protocol in combination with the clustering algorithm. In the clustering algorithm suggested in [1] the mobile nodes form a cluster and the most stable node is made the cluster head. It becomes cluster head's responsibility to send a message to the node of another cluster via the cluster head of that cluster. The cluster head loses its energy with time and so a new cluster head is selected by evaluating the energy of each node in the cluster. In most of the studies clustering algorithm is taken as a base for reducing the interference in network or to maximize the stability and efficiency of the network.

Kashif Dar *et al*. described the structure and general applications of ITS and provided a comparison to other wireless communication systems, whereas Willke *et al*. presented a more comprehensive discussion of this topic as well as d'Orey and Ferreira . IVC is based on the IEEE standard 802.11p which is a modified version of IEEE 802.11a. As in classical mobile communications, the situation is different in the US and Europe, but in general, the principles are the same. The applications can be classified into safety, traffic efficiency and entertainment solutions. Apart from the latter, not a core element of ITS applications, the corresponding protocol mechanisms are based on beacons for vehicular safety and on multi-hop routing and forwarding schemes in case of traffic information. At this point, we want to exclude advanced techniques like further mobile communication systems or background.

Issues and Challenges in VANET

VANET is an application of MANET but it has its own characteristics which can be summarized as:

High mobility: the nodes in VANET usually are moving at a high speed this makes harder to predict a nodes position and making protection of node privacy.

Rapidly changing network topology: due to high node mobility and random speed of vehicle, the position of node changes frequently. As a result of this network topology in VANET tends to change frequently.

Unbounded network size: VANET can be implemented for one city or several city or for countries this means that network size in VANET is geographical unbounded.

Wireless communication: VANET is designed for wireless environment nodes are connected and exchange information via wireless. Therefore some security measure must be considered in communication.

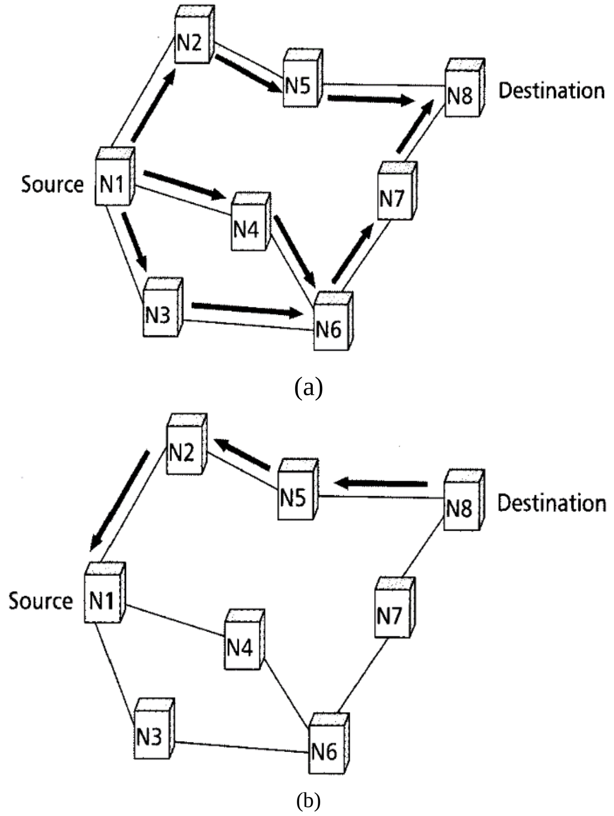
Time critical: The information in VANET must be delivered to nodes within the time limit so that a decision can be made by node and perform action accordingly.

Sufficient energy: The VANET nodes have no issues of energy and computing resources .this allows usage of demanding techniques such as RSA, ECDSA implementation and also provided unlimited transmission power.

III. PROTOCOL IMPLEMENTATION

A new metric is proposed, OFDM based AODV routing protocol to design an enhanced Packet Delivery Ratio and throughput analyzing by using NS-2 simulation. The proposed protocol also considers QOS (Quality of Services) metrics to improve network performance. In our OFDM based AODV we specify cooperative retransmission scheme to identify estimation of interference and retransmission is alternate path. In multiple channel access it increases the throughput and more efficient result and utilizes network performance.

Ad Hoc On-Demand Distance Vector Routing - The Ad Hoc On-Demand Distance Vector (AODV) routing protocol described in builds on the DSDV algorithm previously described. AODV is an improvement on DSDV because it typically minimizes the number of required broadcasts by creating routes on a demand basis, as opposed to maintaining a complete list of routes as in the DSDV algorithm. The authors of AODV classify it as *a pure on-demand route acquisition* system, since nodes that are not on a selected path do not maintain routing information or participate in routing table exchanges. When a source node desires to send a message to some destination node and does not already have a valid route to that destination, it initiates a *path discovery* process to locate the other node. It broadcasts a route request (RREQ) packet to its neighbors, which then forward the request to their neighbors, and so on, until either the destination or an intermediate node with a "fresh enough" route to the destination is located. Fig. 1(a) illustrates the propagation of the broadcast RREQs across the network. AODV utilizes destination sequence numbers to ensure all routes are loop-free and contain the most recent route information. Each node maintains its own sequence number, as well as a broadcast ID. The broadcast ID is incremented for every RREQ the node initiates, and together with the node's IP address, uniquely identifies an RREQ. Along with its own sequence number and the broadcast ID, the source node includes in the RREQ the most recent sequence number it has for the destination. Intermediate nodes can reply to the RREQ only if they have a route to the destination whose corresponding destination sequence number is greater than or equal to that contained in the RREQ. During the process of forwarding the RREQ, intermediate nodes record in their route tables the address of the neighbor from which the first copy of the broadcast packet is received, thereby establishing a reverse path. If additional copies of the same RREQ are later received, these packets are discarded.



(b)

Fig. 1. (a) Propagation of RREQ, (b) Path of the RREQ to sources.

Once the RREQ reaches the destination or an intermediate node with a fresh enough route, the destination intermediate node responds by unicasting a route reply (RREP) packet back to the neighbor from which it first received the RREQ (Fig. 1(b)). As the RREP is routed back along the reverse path, nodes along this path set up forward route entries in their route tables which point to the node from which the RREP came. These forward route entries indicate the active forward route. Associated with each route entry is a route timer which will cause the deletion of the entry if it is not used within the specified lifetime. Because the RREP is forwarded along the path established by the RREQ, AODV only supports the use of symmetric links. Routes are maintained as follows. If a source node moves, it is able to reinitiate the route discovery protocol to find a new route to the destination. If a node along the route moves, its upstream neighbor notices the move and propagates a *link failure notification* message (an RREP with infinite metric) to each of its active upstream neighbors to inform them of the erasure of that part of the route. These nodes in turn propagate the *link failure notification* to their upstream neighbors, and so on until the source node is reached. The source node may then choose to reinitiate route discovery for that destination if a route is still desired.

An additional aspect of the protocol is the use of *hello* messages, periodic local broadcasts by a node to inform each mobile node of other nodes in its neighborhood. Hello messages can be used to maintain the local connectivity of a node. However, the use of hello messages is not required.

Nodes listen for retransmission of data packets to ensure that the next hop is still within reach. If such a retransmission is not heard, the node may use any one of a number of techniques, including the reception of hello messages, to determine whether the next hop is within communication range. The hello messages may list the other nodes from which a mobile has heard, thereby yielding greater knowledge of network connectivity.

IV. SYSTEM MODEL

We consider a vehicular ad-hoc network consisting of one RSU and a set of vehicles moving on a bidirectional four-lane highway. The RSU, as a centralized controller, collects the channel state information and the individual information of active vehicles within its communication coverage and then makes scheduling decisions for each transmission frame. We assume that the RSU has sufficient computational and storage capacity and the vehicles move in a uniform speed within a frame. The RSU and vehicles are equipped with GPS receivers, which can provide fairly accurate time synchronization between network nodes. Each vehicle can get its real-time geographical location and velocity from its GPS receiver. In addition, the packets are categorized into four different ACs, so that vehicles with higher priority packets can have higher probabilities of accessing the channels.

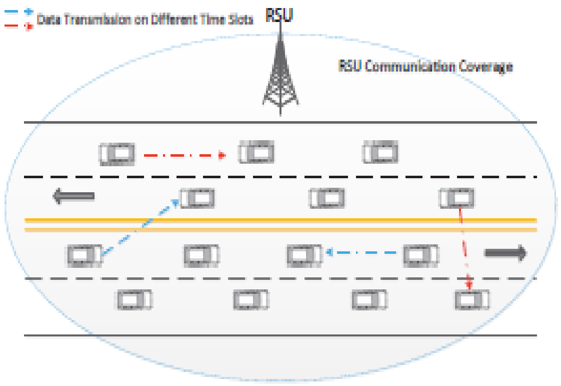


Fig. 2. Proposed VANET model.

In this system (Fig. 2), each transmission frame is sent from the source node to destination by enabling the signal by RSU. Multiple the communication links may request to access channels simultaneously and severe interference may occur in vehicular ad-hoc networks. To avoid interference among different communication links, we proposed a OFDM based AODV protocol for VANET.

While in case of packet or frame lost due to some obstacles in the environment this protocol provides retransmission scheme that to send a data which is lost. And to keep the delay low and to improve the throughput and Packet Delivery Ratio high this protocol is efficient for that.

V. SIMULATION AND RESULTS

A network simulator is a software that predicts the behavior of a computer network. For network complexity to provide accurate understanding of system network simulator is used. It supports several technologies and network such as, WLAN, MANET, VANET, LTE and IOT.

Table 1. Simulation Parameters

Simulation parameters	Values
Simulation area size	6000 × 2300
No of nodes	19
Node movement	Random
Routing	OFDM based AODV
Node configuration	VANET
Simulation time	794.3ms
Traffic model	CBR(Constant Bit Rate)
Propagation model	Two ray propagation model
Packet size	1000 bytes

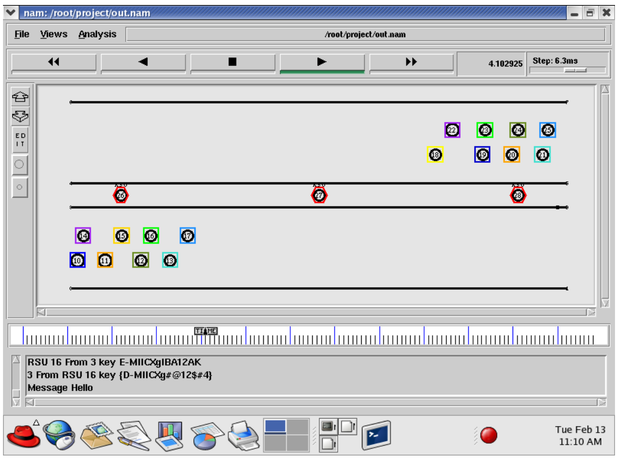


Fig. 3. Node Creation.

Fig. 3 represents node creation, the center three nodes represent Road Side Units (RSU) and other nodes represent vehicle nodes. The other nodes with different color mention different vehicles that may be car, bus, bike, etc., Vehicle node passes through a Road Side Unit (RSU) and acts a cluster head that enables the signal to transmit the data between the vehicle nodes. The scale below the diagram represents the time period.

Parameters Used

$$Throughput = \frac{Average\ data\ rate\ of\ successful\ data}{Time\ taken} \quad (1)$$

$$Delay = \frac{Transmitted\ packet}{Rate\ of\ transmission} \quad (2)$$

$$Packet\ delivery\ ratio = \frac{Number\ of\ packet\ received\ by\ receiver}{Number\ of\ packet\ sent\ by\ the\ sender} \quad (3)$$

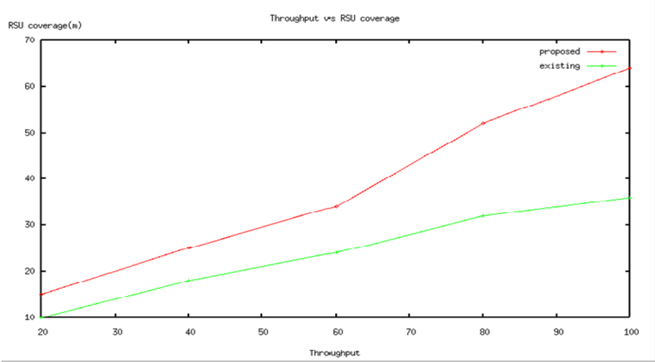


Fig. 4. Throughput VS Roadside Unit (RSU).

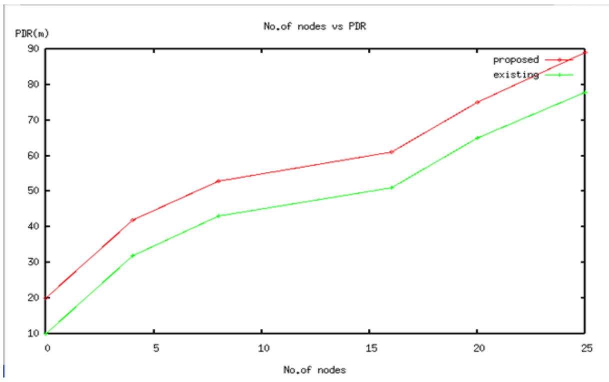


Fig. 5. Throughput VS Communication Overhead.

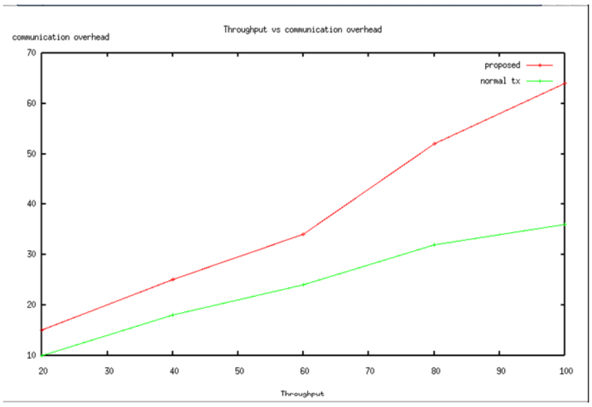


Fig. 6. Number of Nodes VS Delay.

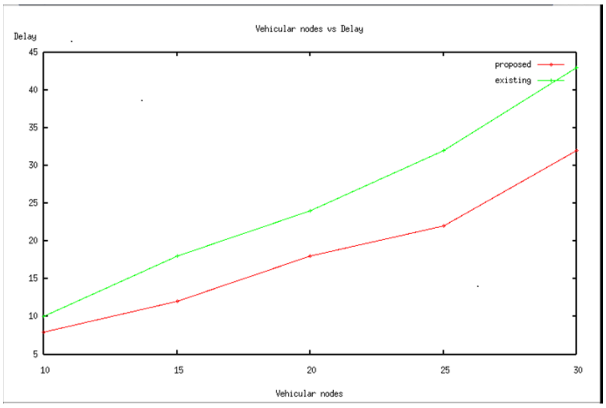


Fig. 7. Number of Nodes VS Packet Delivery Ratio (PDR).

VI. CONCLUSION

VANETs are important types of MANETs because they can help to improve public safety. In this, wireless Mobile nodes establish temporary network connectivity and perform routing function under self organization. In this paper, we have proposed OFDM based AODV protocol that improves the performance issues on TDMA based AODV protocol. The main goal of the OFDM based AODV is to estimate network resources and improve the network performance. Hence there is a congestion in network while using TDMA based AODV protocol will give better performance. OFDM based AODV protocol provides timely and accurate information to achieve high PDR and Throughput. The proposed work improves the end to end delay around 34% and increase PDR around 18% and Throughput at 15%.

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