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Evaluation of Performance Enhancement in VANET using OFDM

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ABSTRACT: Vehicular Ad-Hoc Networks (VANETs) are created by applying the mobile adhoc networks (MANETs) principles. In VANET moving vehicles are used as nodes in a network to create a mobile network. VANET support two types of applications comfort and safety which provides vehicle to roadside and vehicle-to-vehicle communication. These applications are affected by interference in the network.

For reducing the interference in such network Orthogonal Frequency Division Multiplexing (OFDM) is used since it has features like robustness against multipath fading, high data rates, and the conquer the symbol interference. Thus, improves the Signal to Noise ratio in VANET and enhance performance of the VANET.

KEYWORDS: VANET, OFDM, Protocols

I.INTRODUCTION

Vehicular ad hoc networks (VANETs) are a class of wireless networks that is expected to have key role in the intelligent transportation systems. Already in recent years, the U.S. Federal Communications Commission and the European Telecommunications Standards Institute have allocated spectrum for such systems, and an IEEE communications standards for them is under development. VANETs provide vehicle to roadside and vehicle-to-vehicle communication in order to support two main types of applications:

i) Safety applications: - road hazard notification and sending emergency messages from an accident site.

ii) Comfort applications: -parking space availability, traffic-jam notifications, advertisements and traffic estimation.

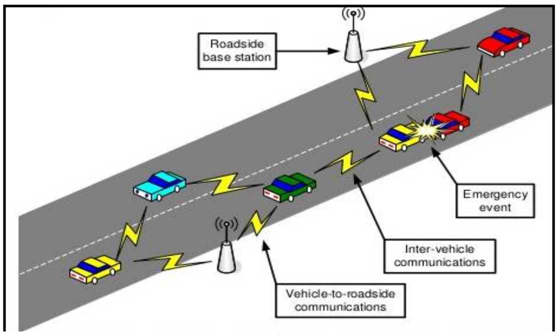

Figure 1: Traffic structure

VANET is subclass of mobile ad hoc networks (MANETs). MANETs uses the topology-based table or source routing algorithms [1]. VANETs are highly dynamic in nature so that uses the different routing algorithms than MANETs mostly those are geographic-based routing [2] and opportunistic carry-and-forward techniques [2], [3] to overcome this challenge.

In VANET nodes have different behavior along roads, no power constraints, small network diameter and frequent topology changes for example cars bypass each other in an intersection or when highways slit before an interchange [4]. If a node wants to transmit a message to the node at large distance, in VANET, the nodes placed between these two nodes bypass the message to the destination node [5]. Thus increasing delay and interference in network. Using OFDM for such network can reduced interference since OFDM have better Signal to Noise Ratio (SNR).

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In this paper, the proposed a system is for enhancing performance of the VANET using OFDM. Unlike some other scheme that consider only reduction of interference in VANET by media access control protocol and a clustering algorithm[6], the system uses VANET with OFDM, which take signal-to-interference-plus-noise ratio into account. This guaranties the enhancement in the performance of VANET using OFDM.

The proposed system uses VANET with OFDM and also uses the CSMA, Scheduling, AODV and MARCH protocols. We also use the various modulation techniques QAM 64, QAM 16, QPSK and BPSK. Finally, the simulative analysis of system and its performance has been discussed.

This paper is organized as follows. In Section I the introduction about paper has been discussed. Section II contains the literature review related to research. Section III contains the proposed model. Simulation of scheme is described in IV. Section V contains result. Section VI contains conclusion.

II.LITERATURE REVIEW

In [6] they designed a system consisting of a clustering algorithm and media access control protocol to reduce interferences in VANETs. They have used the Neighborhood Interference Model also they considered a simple transmission-ranged-based module to determine if nodes correctly receive each other.

In [7] they introduced inter carrier interference (ICI) reduction using self-cancellation, also compared with standard OFDM system. The proposed system gives minimum S/N ratio improvement of about 6dB for QPSK modulation at Doppler frequency of 50Hz, and maximum improvement system is relatively insensitive to Doppler frequency.

OFDM (Orthogonal Frequency Division Multiplexing) has feature its high spectral efficiency and to counteract the frequency-selective fading. The carrier frequency synchronization at the receiver must be performed precisely, to avoid performance degradation in OFDM-based VANET. In [8] they compare the effectiveness of three synchronization algorithms for OFDM-based VANET to calculate the carrier frequency offset (CFO).

In [9] AODV routing protocol performance for Vehicular Ad hoc Networks has been analyzed using 802.11 and 802.llp MAC/PHY standards under TCP and UDP traffic types in urban and highway scenarios. It has also been found that performance of AODV is improved largely by using 802.11 p. Also, AODV can achieve higher PDR with FTP/TCP than CBR/UDP but the situation is reverse with respect to E2ED.

In [10] they target at minimizing the total transmission energy while guaranteeing the transmission reliability and the transmission reliability the timeliness of safety messages for inter-vehicle communications, so that radio interference and collision reduced, and cut down the carbon footprint of cars. They designed a mixed integer linear programming model to define this problem. There are four different methods are proposed to express the wireless power in linear equations. The evaluation the performance of the obtained safety message delivery tree conducted by simulation, which may give some inspire for developing heuristic algorithms. The scheduling based protocol will be helpful for achieving the high-level energy efficiency to prolong network lifetime.

In [11] they have introduced a single channel MAC protocol for multihop ad hoc wireless networks known as MARCH. MARCH provides better throughput, delay and control overhead performance by reducing the number of handshakes. The simulation results reveal that MARCH outperforms MACA in several respects. MARCH is a protocol that exploits the case that neighbors overhear control messages, therefore it does not resort to network prediction, unlike most receiver-initiated protocols and it is more deterministic.

III. PROPOSED MODEL

A. **VANET**: VANETs are a subclass of MANETs, which uses vehicle mobile nodes to provide communication among nearby vehicles, between vehicles, and nearby road equipment but apparently differ from other networks by their own characteristics. The moving nodes (vehicles) in VANETs are limited to road topology, when the road information is ready, the position of the vehicle will be predictable. However, VANETs comes with the several challenges like high mobility and large scale. In a vehicular network, nodes are highly movable because most vehicles usually are change their position constantly and having high speed. VANET network is more dynamic in nature thus increases interferences in network.

B. **OFDM**: OFDM is the multicarrier modulation that is being used for many latest telecommunication and wireless standards. It has been adopted by telecommunication standard LTE/ LTE-A and by other standards such as WiMAX and many more. OFDM has high data rate this is because of features like it has immunity to selective fading, resilience to interference, spectrum efficiency, resilient to inter-symbol interference (ISI), resilient to narrow-band effects, simpler channel equalization. Because of these features of OFDM the OFDM based VANET will improve its performance in network.

C. **Protocols**:

i. **CSMA Protocol:** Carrier sense multiple access (CSMA) is a media access control (MAC) protocol. In CSMA before transmission of the data on a shared transmission medium such as an electrical bus, or a band of the electromagnetic spectrum, a node checks the absence of other traffic. A transmitter attempts to determine whether another transmission is in progress before initiating a transmission that's why it called as carrier sense. That is, before transmission it tries to detect the presence of a carrier signal from another node. The node waits for starting its own transmission until another transmission in progress is not ended. In other words, CSMA is used two principles one is "listen before talk" and another one is "sense before transmit".

ii. **AODV Protocol**: Ad hoc On-demand Distance Vector (AODV) routing protocol. It is an important routing protocol used in VANET system. AODV is a reactive routing protocol. It is based on topology based routing protocol. The AODV routing algorithm enables multi-hop, dynamic, routing, self starting between participating moving nodes wants to establish and maintain an ad-hoc networks. AODV routing algorithm is dynamic in nature, so it also allows highly mobile nodes to create routes very quickly to find new destination, nodes which are not connected, is not necessary to maintain this routes.

iii. **Scheduling Protocol**: Scheduling protocol improves power management in wireless adhoc network.

iv. **MARCH Protocol:** The Multiple Access with Reduced Handshake (MARCH) protocol improves the communication throughput in wireless multihop ad hoc networks since it reduces the amount of control overhead. MARCH protocol is different from other receiver-initiated protocols. It operates without resorting to any traffic prediction. This protocol reduces the number of required handshakes since it exploits the broadcast characteristic of omni-directional antennas.

D. **Modulation Techniques**:

i. **BPSK**: BPSK is the simple form of phase shift keying (PSK). It uses two phases which are separated by 180°. It is also called as 2-PSK. BPSK modulation is the most robust of all the PSKs. It takes the highest level of distortion or noise to make the demodulator reach an incorrect decision.

ii. **QPSK**: QPSK transmits twice the data rate in a given bandwidth compared to BPSK. It is also called as quadriphase PSK, 4-PSK, or 4-QAM.

iii. **QAM 16**: 16-QAM modulation, the symbol size is $k = \log2(16) = 4$ bits.

iv. **QAM 64:** In 64-QAM, each symbol is represented by 6 bits.

IV. SIMULATION

Figure shown below is the snapshot of working model. The model is build using software Lab View on 64 bit Windows operating system.

Message signal is transmitted by node. Signal type can be choosing as sine wave, sawtooth wave, square wave and triangular wave. The signal is transmitted with the noise as the VANET affected by various noise. So, noise is transmitted with the message signal. The signal is recovered by using the Hilbert filter modulation technique. Reduction of noise is shown in the figure (2).

The main objective is to improve the signal to noise ratio. The OFDM is applied with the various modulation schemes as BPSK, QPSK, QAM 16 and QAM 64 since OFDM has the feature of multicarrier modulation. Also MARCH, Scheduling, AODV and CSMA these different protocols are used. Each protocol used with the all modulation schemes. The graph shows the BER vs SNR for respective protocol and modulation scheme. Figure (3) shows improved SNR with OFDM.

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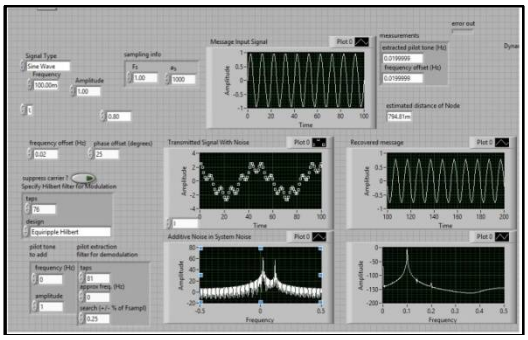

Figure 2: Reduction of Noise

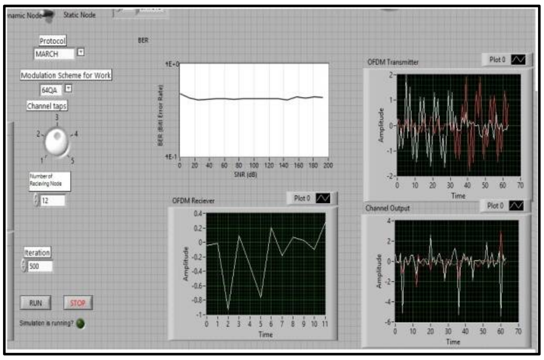

Figure 3: Improved SNR with OFDM

V. RESULT

The following graphs show the BER vs SNR for different protocols under various modulation schemes using OFDM in VANET.
The figure 4 shows the BER vs SNR for scheduling protocol under BPSK modulation scheme.

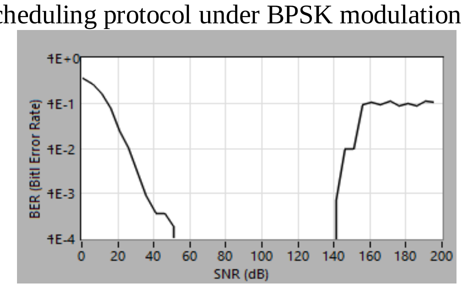

Figure 4: BER vs SNR for scheduling protocol under BPSK modulation

The figure 5 shows the BER vs SNR for scheduling protocol under QPSK modulation scheme.

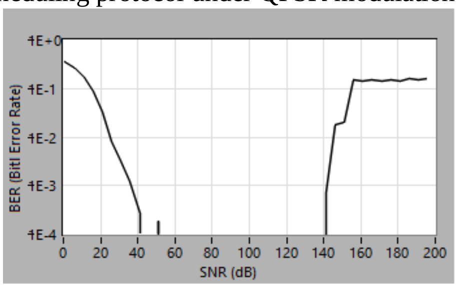

Figure 5: BER vs SNR for scheduling protocol under QPSK modulation

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The figure 6 shows the BER vs SNR for scheduling protocol under QAM16 modulation scheme.

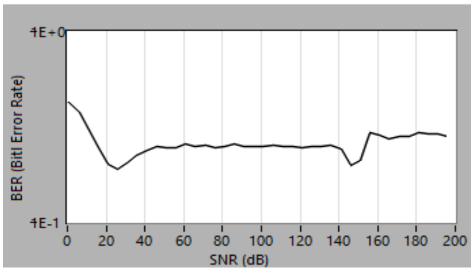

Figure 6: BER vs SNR for scheduling protocol under QAM16 modulation

The figure 7 shows the BER vs SNR for scheduling protocol under QAM64 modulation scheme.

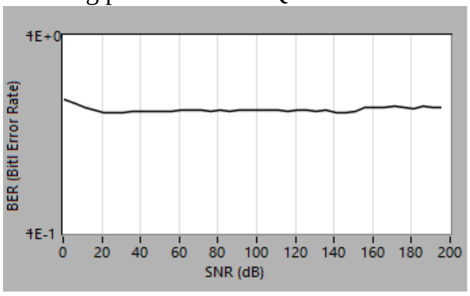

Figure 7: BER vs SNR for scheduling protocol under QAM64 modulation

The figure 8 shows the BER vs SNR for MARCH protocol under BPSK modulation scheme.

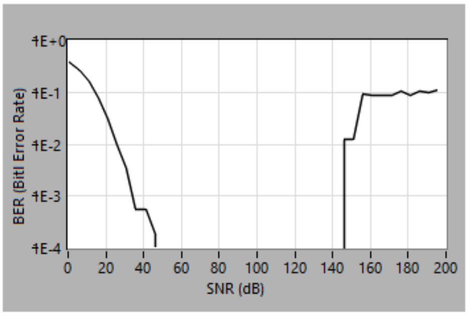

Figure 8: BER vs SNR for MARCH protocol under BPSK modulation

The figure 9 shows the BER vs SNR for MARCH protocol under QPSK modulation scheme.

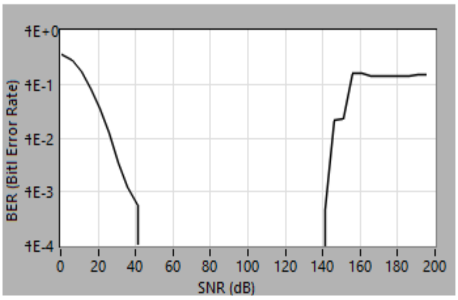

Figure 9: BER vs SNR MARCH protocol under QPSK modulation

The figure 10 shows the BER vs SNR for MARCH protocol under QAM16 modulation scheme.

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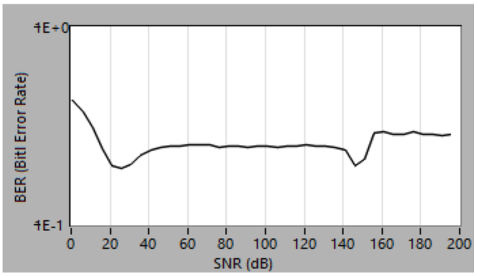

Figure 10: BER vs SNR MARCH protocol under QAM16 modulation

The figure 11 shows the BER vs SNR for MARCH protocol under QAM64 modulation scheme.

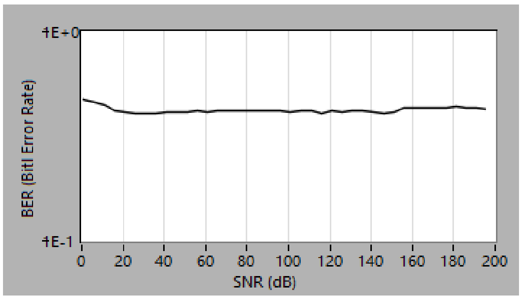

Figure 11: BER vs SNR MARCH protocol under QAM64modulation

The figure 12 shows the BER vs SNR for CSMA protocol under BPSK modulation scheme.

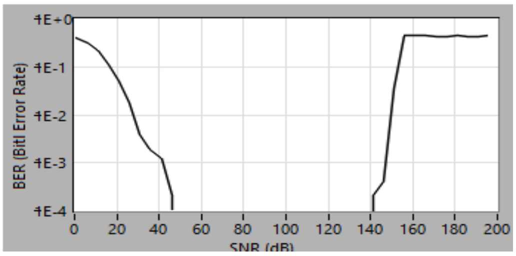

Figure 12: BER vs SNR CSMA protocol under BPSK modulation

The figure 13 shows the BER vs SNR for CSMA protocol under QPSK modulation scheme.

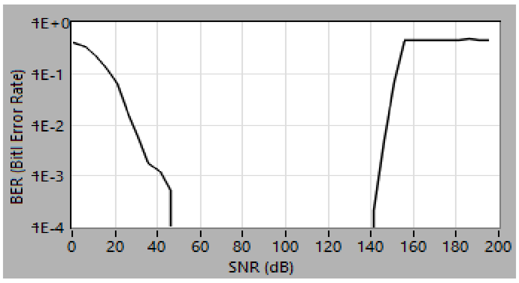

Figure 13: BER vs SNR CSMA protocol under QPSK modulation

The figure 14 shows the BER vs SNR for CSMA protocol under QAM16 modulation scheme.

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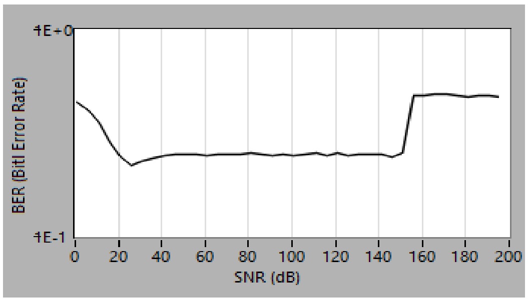

Figure 14 BER vs SNR for CSMA protocol under QAM16 modulation

The figure 15 shows the BER vs SNR for CSMA protocol under QAM 64modulation scheme.

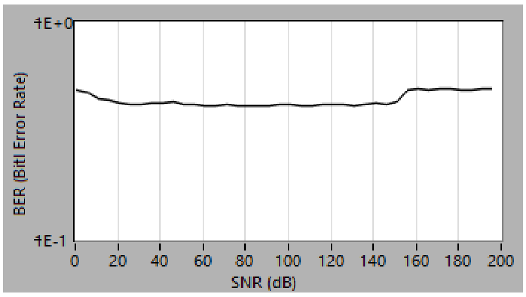

Figure 15: BER vs SNR for MARCH protocol under QAM 64modulation

The figure 16 shows the BER vs SNR for AODV protocol under BPSK modulation scheme.

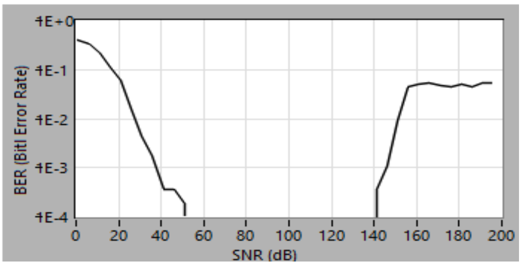

Figure 16: BER vs SNR for AODV protocol under BPSK modulation

The figure 17 shows the BER vs SNR for AODV protocol under QPSK modulation scheme.

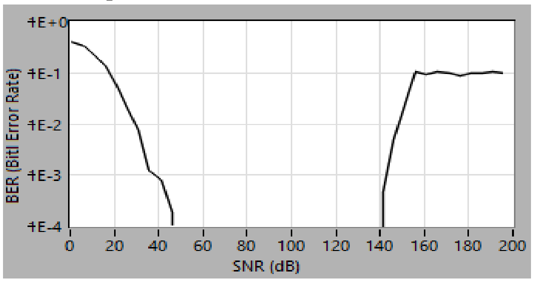

Figure 17: BER vs SNR for AODV protocol under QPSK modulation

The figure 18 shows the BER vs SNR for AODV protocol under QAM16 modulation scheme.

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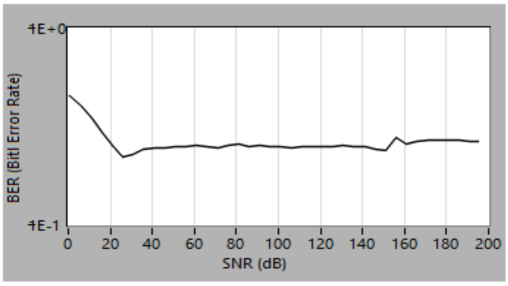

Figure 18: BER vs SNR for AODV protocol under QAM16 modulation

The figure 19 shows the BER vs SNR for AODV protocol under QAM64 modulation scheme.

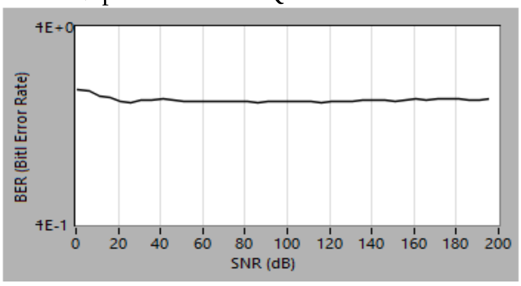

Figure 19: BER vs SNR for AODV protocol under QAM64 modulation

From the graphs it has been that BER vs SNR improved with the OFDM in VANET for different protocols.

VI.CONCLUSION

VANET network causes with interferences. Various techniques are there to reduce the interferences. Here we used the OFDM to improve the performance of the VANET. In this paper we reduce the interference in VANET also improves the single to noise ratio by using OFDM. Also we analyze the BER Vs SNR for various protocols under different modulation scheme.

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