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PERFORMANCE EVOLUTION OF VEHICULAR AD-HOC NETWORK FOR INTER VEHICLE COMMUNICATION UNDER DIFFERENT MODULATION TECHNIQUE

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ABSTRACT

Vehicular Ad-hoc Networks (VANETs) are self-organized networks built up from moving vehicles, and are part of the broader class of Mobile Ad-hoc Networks (MANETs).

Inter vehicle communication is the part of VANET and play major role in many applications of VANET. This paper compares the performance of inter vehicle communication in different modulation technique for this we use matlab simulation plate form. Second part of this paper shows the relation between Bit Error Rate and Distance of wireless channel under different modulations.

INTRODUCTION

Recent year's rapid development in wireless communication networks has made Inter-Vehicular Communications (IVC) and Road-Vehicle Communications (RVC) possible in Mobile Ad Hoc Networks (MANETs), this has given birth to a new type of MANET known as the Vehicular Ad Hoc Network (VANET), aiming to enable road safety, efficient driving, and infotainment. The world today is living a combat, and the battle field lies on the roads, the estimated number of deaths is about 1.2 million people yearly worldwide, and injures about forty times of this number, without forgetting that traffic congestion that makes a huge waste of time and fuel .Vehicular Ad hoc Networks (VANET) is part of Mobile Ad Hoc Networks (MANET), this means that every node can move freely within the network coverage and stay connected, each node can communicate with other nodes in single hop or multi hop, and any node could be Vehicle, Road Side Unit (RSU).

Since inter vehicle communication in VANETs is similar to communication in mobile ad-hoc networks (MANETs) the protocols are also similar. It is envisioned [1] to basically apply ad-hoc communication according to IEEE 802.11 but without the need to form a basic service set in order to improve the ad-hoc capabilities. The respective amendment, IEEE P802.11p is currently under development.

In this paper we present performance of communication in VANET using WLAN in different modulation.

BACKGROUND OF VEHICULAR COMMUNICATIONS

The original motives behind vehicular communications were safety on the road, many lives were lost and much more injuries have been incurred due to car crashes. A driver realizing the brake lights of the car in front of him has only a few seconds to respond, and even if he has responded in time cars behind him could crash since they are unaware of what is going at the front [1]. This has motivated one of the first applications for vehicular communications, namely cooperative collision warning which uses vehicle to vehicle communication. Other safety applications soon emerged as well as applications for more efficient use of the transportation network, less congestion and faster and safer routes for drivers. These applications cannot function efficiently using only vehicle to vehicle communications therefore an Infrastructure is needed in the form of RSU. Although safety applications are important for governments to allocate frequencies for vehicular communications, non safety applications are as important for Intelligent Transportation Systems (ITS) for three reasons [2]:

1) ITS systems rely on essential equipment which should be installed in every car and is widely available to the users. However, it is unlikely that individuals can afford such expensive equipment.

2) Safety applications generally require limited bandwidth for short intervals of time. Since bandwidth efficiency is an important factor, non safety applications are important to increase band width efficiency.

3) The availability of RSU provides an infrastructure which can be used to provide a lot of services with only a little increase in cost. Besides road safety, new applications are proposed for vehicular networks, among these are Electronic Toll Collection (ETC), car to home communications, travel and tourism information distribution, multimedia and game applications just to name a few. However these applications need reliable communication equipment which is capable of achieving high data rates and stable connectivity between the transmitter and the receiver under high mobility conditions and different surroundings.

NETWORK PARAMETERS CONFLICT ON TRANSMISSION POWER IN VANET

Transmission range is directly proportional to the transmission power of the moving node. If the transmission power will be high, the interference increases that can cause higher delay in message response at receiver end. Hence, the performance of the network decreases. Also, it is analyze that how transmission power can be controlled by consider different parameter of the network such as; density, distance between moving nodes, different types of messages dissemination with their priority, selection of an antenna also affects on the transmission power [3].

Density is one of the parameter that affects the transmission of the packets. Due to high number of vehicular nodes, the transmission medium becomes congested and possibility of higher number of collision increases that could decrease the performance of the vehicular network. Density of the network can be classified into two groups; one is basically by counting the number of vehicular nodes and the other is number of clusters of vehicular nodes that comprise the network [4].

Distance is also an important factor that affects the transmission range of the vehicular ad hoc networks. If the nodes as far away from each other, the transmission link between the nodes will be weak due to response of lower power transmission signal. The nodes closer will be the stronger the signal strength between them. Distance also affects the density of the network, if the distance between the nodes will be more, the density will be lesser and vice versa [5].

$$P_r = P_t\left(\frac{4\pi df}{3*10^8}\right)^2$$

P_r = Received Power
P_t = Transmitted Power
d = Distance
f = Frequency

PROPOSED MODEL

In this section, we first explain the proposed architecture of VANET and then explain the simulation setup which we have used.

A. VANET Architecture

Fig.1 shows basic architecture of our simulation environment. In this figure multiple vehicles passing through parallel roads. The circle represents the area where communication between two or more vehicle takes place.

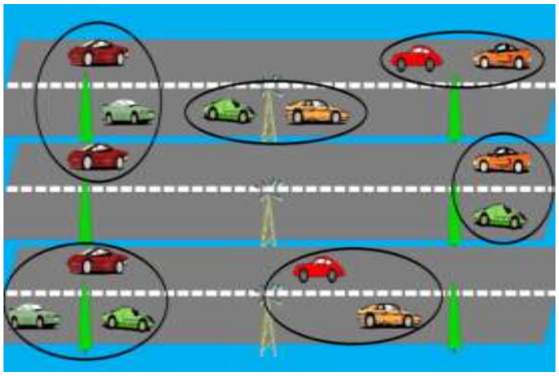

Figure.1. Basic Architecture of Simulation Environment

B. Simulation Setup

To evaluate the performance of VANET network we have proposed we first simulate it using matlab platform. We simulate our network for the area covering 10^4 sqm. with length and width of 100 m each. On the simulation model we are using 802.11g for WiFi network in vehicle to communicate each other. In the fig. 55 blue dots represents the vehicle on roads and red circles shows the spot where moving vehicle communicate each other. The roads are 10 m apart from each other. In our simulation we are using lousy having free space path loss for WiFi network.

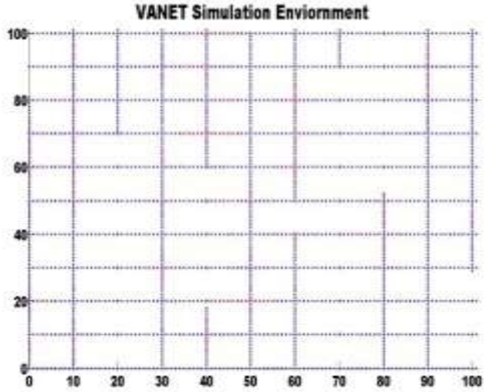

Figure.2. Matlab Simulation Plate Form

The performance of above described VANET is explained for BER vs. Distance and Utilization Factor vs. Number of Nodes.

C. Simulation Parameters

S.No.	Wi-Fi 802.11g	
1	Frequency	2.4 GHz
2	Bandwidth	20 MHz
3	Modulation Technique	BPSK, QPSK, 8 QAM, 16 QAM
4	Data Rate	1.54 Mbps
5	Indore Range	38 m
6	Outdoor Range	104 m
7	License	No

PERFORMANCE EVALUATION

The performance of Vehicular Communications is depending on total number of vehicle and modulation technique used in WLAN. We have investigated number of communicated vehicle pair vs. number of nodes, where number of the nodes represents total number of vehicle in vehicular network, for different modulation scheme such as BPSK, QPSK, 8-QAM and 16 QAM. In this paper we also focus on how Bit Error Rate (BER) varies with distance of transmitted signal which depends on different modulation schemes.

A. Number of Communication (NoC) vs. Number of Nodes (NoN):

For BPSK (M=2):

In Figure 3 Utilization Factor is evaluated with respect to Number of Nodes (NoN) for BPSK modulation. Utilization Factor depends on range of wireless signal. In BPSK Modulation, range of signal is greater than range created by

QPSK and 16 QAM. In this figure we see that graph starts with zero coordinate and attend maximum value of 780 at 50 nodes. The slope of the graph changes three times. In between graph shows UF=174 at NoN=30, UF=335 at NoN=40 and UF=780 at NoN=50.

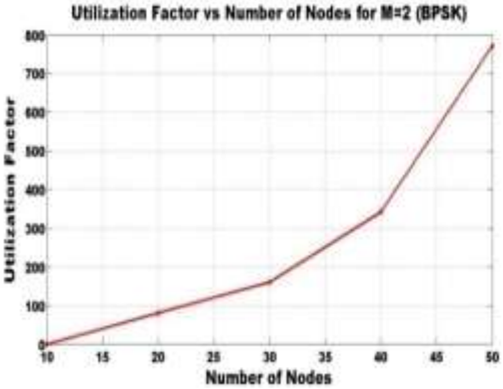

Figure.3. Utilization Factor vs. Number of Nodes for BPSK

For QPSK (M=4):

In Figure 4 Utilization Factor is evaluated with respect to Number of Nodes (NoN) for QPSK modulation. In QPSK Modulation, range of signal is greater than range created by 8 QAM and 16 QAM. In this figure we see that graph starts with zero coordinate and attend maximum value of 240 at 50 nodes. The slope of the graph changes three times. In between graph shows UF=140 at NoN=30, UF=135 at NoN=40 and UF=240 at NoN=50.

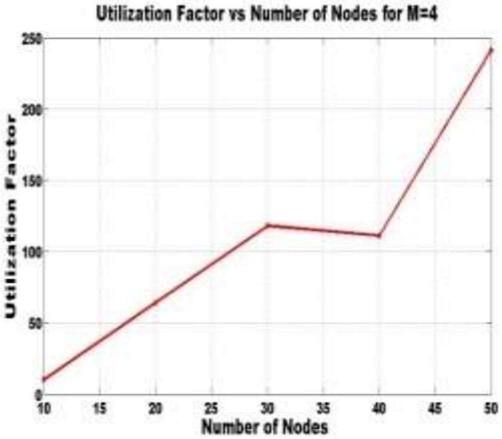

Figure.4. Utilization Factor vs. Number of Nodes for QPSK

For 8-QAM (M=8):

In Figure 5 Utilization Factor is evaluated with respect to Number of Nodes (NoN) for 8 QAM modulation. Utilization Factor depends on range of wireless signal. In BPSK Modulation, range of signal is greater than range created by 16 QAM but less than BPSK and QPSK. In this figure we see that graph starts with zero coordinate and attend maximum value of 85 at 50 nodes. The slope of the graph changes Four times. In between graph shows UF=40 at NoN=20, UF=63 at NoN=30, UF=35 at NoN=40 and UF=85 at NoN=50.

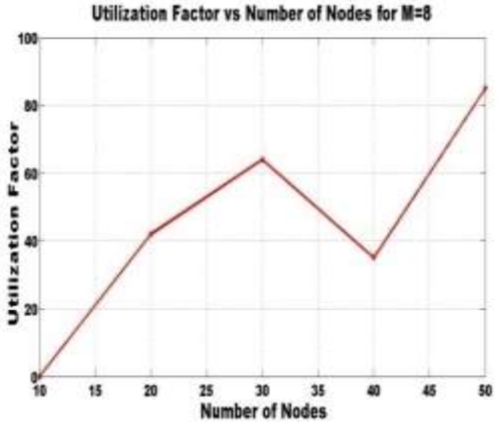

Figure.5. Utilization Factor vs. Number of Nodes for 8-QAM

For 16-QAM (M=16):

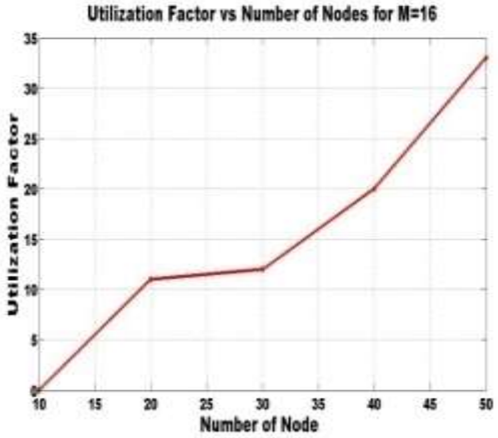

Figure.6. Utilization Factor vs. Number of Nodes for 16-QAM

In Figure 6 Utilization Factor is evaluated with respect to Number of Nodes (NoN) for 16 QAM modulations. In 16 QAM Modulation, range of signal is minimum in comparison to other modulation but signal quality is much batter. In this figure we see that graph starts with zero coordinate and attend maximum value of 33 at 50 nodes. The slope of the graph changes Four times. In between graph shows UF=11 at NoN=20, UF=12 at NoN=30, UF=20 at NoN=40 and UF=33 at NoN=50.

Bit Error Rate (BER) vs. Distance (m) for different modulation

For BPSK (M=2):

In Figure 7, BER is evaluated with respect to distance for BPSK modulation. From this Figure it is clear that for Wi-Fi distance up to 30m BER, start from zero; attain 0.865 for BPSK.

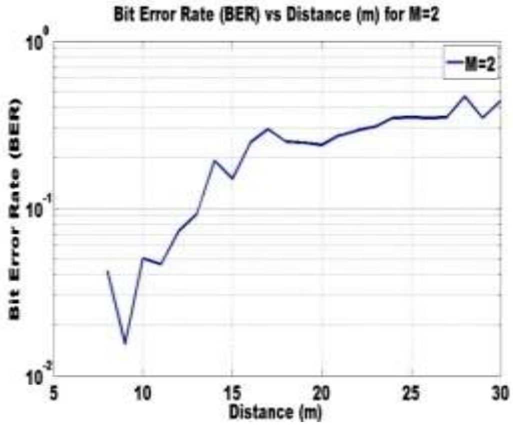

Figure.7. BER vs. Distance for BPSK

For QPSK (M=4):

In Figure 8, BER is evaluated with respect to distance for BPSK modulation. From this Figure it is clear that for Wi-Fi distance up to 30m BER, start from zero; attain 0.865 for QPSK.

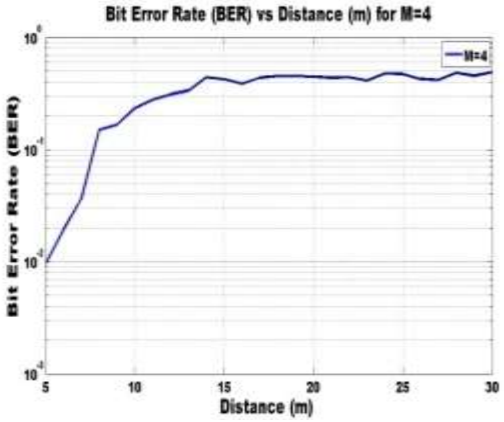

Figure.8. BER vs. Distance for QPSK

For 8-QAM (M=8):

In Figure.9, BER is evaluated with respect to distance for BPSK modulation. From this Figure it is clear that for Wi-Fi distance up to 30m BER, start from zero; attain 0.865 for 8 QAM.

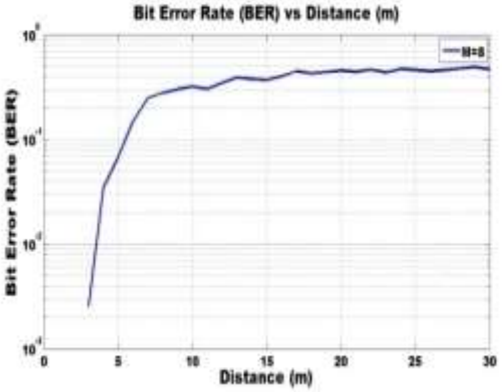

Figure.9. BER vs. Distance for 8-QAM

For 16-QAM (M=16):

In figure 10, BER is evaluated with respect to distance for BPSK modulation. From this figure it is clear that for Wi-Fi distance up to 30m BER, start from zero; attain 0.865 for BPSK.

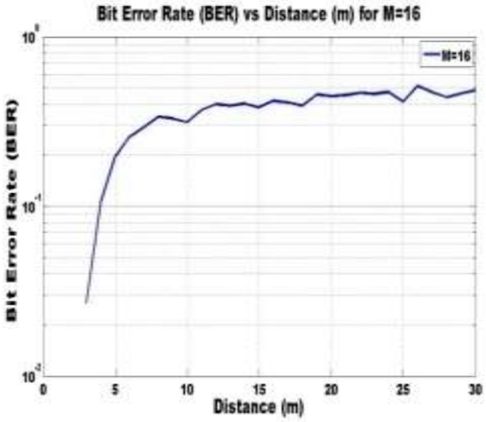

Figure.10. BER vs. Distance for 16-QAM

CONCLUSION AND FUTURE SCOPE

In this paper, we discussed some results of inter-vehicle communication experiments using IEEE 802.1lg wireless-LAN. At first, we study communication held between vehicle for BPSK, QPSK, 8 QAM and 16 QAM. These experiment confirmed that the communications between vehicles increases when range of signal increase this means in BPSK modulation number of communication are highest and it decreased when we use QPSK, 8 QAM and 16 QAM.

In second part of this paper we reported bit error rate performance of inter-vehicle communications with different modulation.

Result shows that bit error rate increase with distance for all modulation but it has higher peaks in 8 QAM and 16 QAM.

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