Performance Analysis of Modulation Schemes under Fading Scenario

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Abstract- **There has been a sudden increase in technology over the last few decades and all modern generation communication tools are still dependent on digital information transmission. Thus, by implementing better digital modulation techniques, it has become possible to provide more and more reliable services to users. The word fading, in communications context, refers to the interference caused by the transmission at an antenna of various dispersed copies of a given signal. Fading can cause large spontaneous fluctuation in signal strength – on a scale of 10s of dBs over fractions of a wavelength and can therefore be highly damaging to the signal. This paper discusses the efficiency of various digital modulation schemes including different type of phase shift keying BPSK) and different type of Quadrature amplitude modulation (QAM) , calculate the BER and signal to noise ratios in AWGN, Rayleigh and Rician fading channels using LabVIEW.**

Keywords – BPSK, QPSK, 8-PSK, 4-QAM, 8-QAM and 16-QAM, BER, AWGN, and Rayleigh fading channels, Rician fading channel LabVIEW.

I. INTRODUCTION

Communication is the act of sending or receiving information between two or more persons from one individual to another conventional communication systems use analog signal to communicate on long distance. But these system suffer many losses, such as interference, distortion, attenuation as well as other losses. To solve these issues, the analog signals are digitized allowing for simpler and more reliable communication without error. The necessity for the existence of many scatters means that Rayleigh fading is a very use full model in densely buildup urban areas where there are no transmission line-of-sight (LOS) paths between the transmitters and receiver. When the signal is reflected, refracted, attenuated and diffracted by various structures, cars, and other objects, the power level of the transmitted signal would be almost distributed to Rayleigh fading. The cellular phone systems are one of the most significant Rayleigh fading models, since in general there is no LOS track between handset and base stations.

Channel modelling allows the channel activity to be demonstrated from fading statistics by measuring and calculating the different parameters. Such parameters are derived from the communication system’s model of design and performance evaluation. Deterministic channel models and statistical models are divided into two major groups. The models are derived from the signals obtained, their correlation and their distribution through empirical measurements. In digital communication system channel modelling takes major role in the communication it modelling a channel measures all the physical processing of a transmitter signal to the receiver. In this paper uses a AWGN and Fading channels. Rayleigh and Rician distribution are usually modeled for the multipath delay of the wireless communication. Two models are used in Rayleigh and Rician channel model i.e. Jakes and Gans model.

Jakes and Gans model

Due to its simplicity, the Jakes method has gained considerable popularity. The model Jakes, which was used in order to calculate in the first instance the power spectrum, is imitated in Gaussian with statistical information corresponding to the isotropic scattered. However, Jakes' simulator is an established method to simulate Rayleigh-related flat fading waveforms. It is a deterministic model of fading. For simulations of selective frequency and variety combined fading channels, there are several uncorrelated fading shapes that Jakes' model can extend. The jakes model also popularized the Doppler spectrum, which is often referred to as the jakes spectrum, associated with the fading Rayleigh. In the Jakes model it can still be reduced, although the cross-correlation was smaller than the Clarke model. In order to include the Doppler Effect, Gans developed a spectrum analysis for the Clarke model. Ideally, each generated waveform should not be linked to the other but Clarke’s model showed a very high cross-relation. The jakes and gans model works on the Doppler principle.

II. FADING SCENARIOS

Radio waves propagate and pass across space from a transmitting antenna, undergoing refraction, reflection, diffraction and scattering. The transmitted signal arrives at the receiver through several routes and creating a multipath situation with different time delay. Such waves with uniformly spaced envelopes and phases on the receiver combine to give an outcome signal that fluctuate space and time.

Two forms of fading defined for the mobile radio service. Small-scale fading is called short-term fluctuation in the signal envelope, induced by the local multipath. A condition like this is observed over distances of approximately half a wavelength. The word “small-scale fading” refers to the rapid variations in a received signal envelope. Small-scale fading consists of two types i.e. Multipath time delay spread and Doppler spread. The second fading form is called Large-scale fading. The term Large-scale fading denotes the variations in a received signals mean envelope or mean power. It is believed to be a slow method and usually based on lognormal statistics. In this channel variation is not takes place with time it will undergo reflection, refraction, diffraction and scattering. Large-scale fading includes path loss and shadowing effect.

III. IMPLEMENTATION IN IDEAL COMMUNICATION

The main structure includes amplitude, frequency or phase of the carrier’s signal as a response to 1’s and 0’s patterns.

A.BPSK

This is the simplest digital modulation scheme in which in response to input bits 1’s and 0’s, the phases are switched. For binary shift keys also known as 2PSK or phases reversal keys, the phases are divided by 180, and the maximum modulation rate is 1 bit / symbol.

B.QPSK

It is a type of PSK that uses two-bit (00, 01, 10 & 11) combination. Four potential carrier phase changes (0, 90,180 & 270) reflect each of these bit combinations. For QPSK it is possible to transmit twice as much information as ordinary PSK using the same bandwidth. This schemes is useful in applications with high data levels such as video conferencing, mobile phone networks etc. For four phases you can encode two bits per symbol.

C.QAM

It is an analog and digital modulation system that transmits two message signals, either via AM analog modulation schemes or via ASK digital modulation schemes to adjust the amplitude of the waves of the two carriers. The two waves of the same frequency are 90 degrees out of phase and are thus called carriers quadrature or quadrature elements. Both modulated waveforms are summed up and in an analog scenario, both PSK and ASK or PM and AM are mixed.

D.BER

Bit error determines the error number or bits per unit time. In digital communication, the number of bits received in a data stream through a communication channel is the number of bits which are altered by either noise, interruption, distortion or bit syncing, attenuation, fading wireless, etc.

E.AWGN

It is one of the channel models, where a linear introduction of white noise with a constant spectral density and a Gaussian amplitude distribution function is an only deficiency in communication. This model does not take fading, interference, non-linearity or dispersion into account, but rather produces simple models which provide an overview on the basic behavior of the system.

IV. IMPLEMENTATION IN IDEAL LABVIEW

LabVIEW provides the tools to solve code problems and an extensive collection of VIs and data creation, analysis, display and storage functions. Another benefit of LabVIEW is that the input parameters and outcomes can be varied by adjusting the correct block in the front panel. LabVIEW has integrated analytical capacities that include signal generation, analysis, processing of standard digital and analog modulation formats and personalized modulations. All these can be accomplished by means of a modulation toolkit that is implemented in LabVIEW. This toolkit enables users to quickly create custom apps for analysis, design, characterization, validation and testing of communications systems and components that are used for signal modulation and demodulation. Analog and digital modulation system, such as AM, FM, PM, ASK, FSK, MSK, GMSK, PSK, QPSK, PAM and QAM, are used for specific modulation toolkit applications.

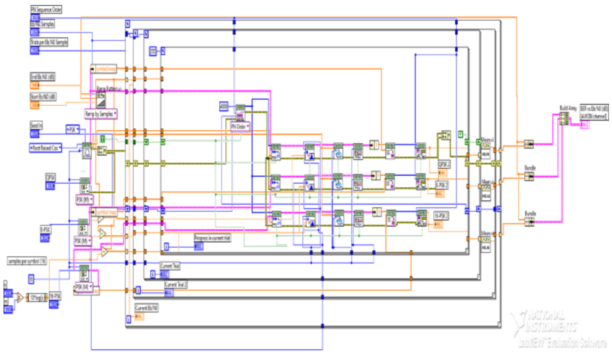

Figure 1. PSK modulation in AWGN channel.

A number of distinct signals represent digital data are used to represent any digital modulation system. PSK uses a number of phases, each with a single binary digit pattern. Each stage usually encodes the same amount of bits. Every pattern of bits constitutes the symbol of the phase in question. The figure 5.1 shows the PSK in LabVIEW. Here the BER in QPSK, 8-PSK and 16-PSK are compared. In QPSK sends two bits per symbol, 8-PSK sends three bits per symbol, 16-PSK sends four bits per symbol.

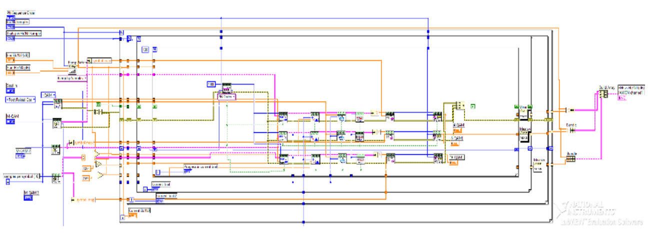

Figure 2. QAM modulation scheme using AWGN channel.

At QAM, two independent signals can be modulated and forwarded to the recipient point. And the channel bandwidth also increases by using the two input signals. Two message signals can be sent from QAM across the same channel. This MAQ technique is often referred to as "quadrature carrier multiplexing".

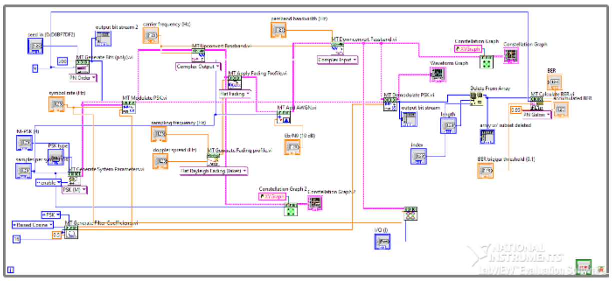

Figure 3. PSK modulation using Fading Channel.

PN sequence generator generates inputs bits and these inputs bits send to the PSK modulation block. PSK system parameter and filter coefficient block also given input to the PSK modulation block. In PSK system parameter block we select PSK type i.e. QPSK, 8-PSK and 16-PSK. And filter coefficient block is used to reduce the inter symbol interference and specifies pulse shaping filter coefficient. These two parameter given as an input to the PSK modulation block. After these we adding fading profile to modulation block. The waveform faded can be used to test the immunity of receivers to fading channels. Generates a user-defined Rayleigh or Rician waveform fading profile. To apply the created profile to the I/Q baseband waveform call the MT apply Fading Profile VI. This VI can be used to model Rayleigh and Rician fading profile distributions by using Gans and Jakes models for the selective fading of flat-fading channels and times. After the fading channel we add AWGN channel because to adding Gaussian noise to demodulation and Eb/N0 value for calculating BER. The fading channel mainly working on the basis of Doppler spread. After the AWGN channel we add PSK demodulation to calculate the BER with respect to the Doppler spread.

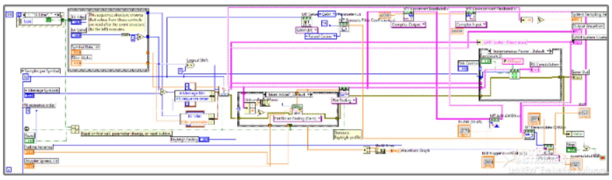

Figure 4. QAM modulation in fading channel.

In a QAM modulation design is same as the PSK modulation design only change is in the system parameter we select QAM instead of PSK. But in QAM we use the QAM transmitter because in their QAM transmitter we take all the parameter what QAM required. Filter coefficient and system parameter all are there in QAM transmitter.

V. SIMULATION RESULTS

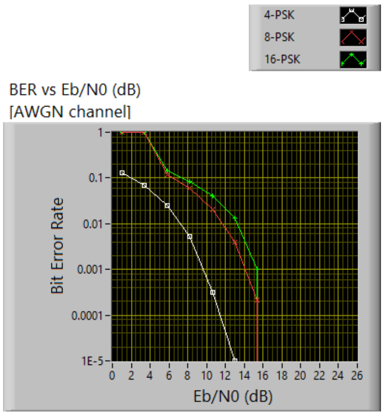

Figure 5. PSK Modulation in AWGN channel.

In this AWGN channel show QPSK as lower BER compare to 8-PSK and 16-PSK because the QPSK is send 2 bits per symbol and varies from 1dB to 12.5dB. After reaching 12.5dB the BER goes to 0. But in 8-PSK and 16-PSK its send data is 3 bits per symbol and 4 bits per symbol and 8-PSK varies from 2dB to 15dB, up to 2dB BER is 1 once reaching the 2dB its start to varying BER and its reaches 15dB the BER goes to 0. In 16-PSK varies from 3.9dB to 15.8dB, up to 3.9dB BER is 1 once reaching the 3.9dB its start to varying BER and its reaches 15.8dB the BER goes to 0. When Eb/N0 value increases BER is decreases. So QPSK achieve low BER compare to 8-PSK and 16-PSK in AWGN channel.

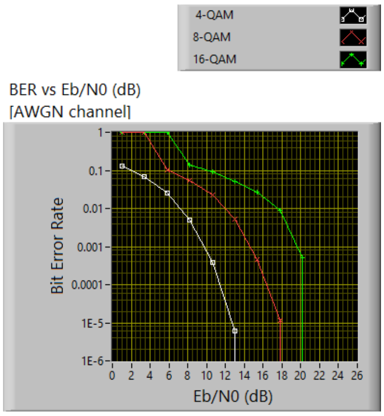

Figure 6. QAM modulation in AWGN channel.

In this AWGN channel show QAM as lower BER compare to 8-QAM and 16-QAM because the QAM is send 2 bits per symbol and varies from 1dB to 13dB. After reaching 13 dB the BER goes to 0. But in 8-QAM and 16-QAM its send data is 3 bits per symbol and 4 bits per symbol and 8-QAM varies from 3.8dB to 17.9dB, up to 3.8dB BER is 1 once reaching the 3.8dB its start to varying BER and its reaches 17.9dB the BER goes to 0. In 16-QAM varies from 6dB to 20.1dB, up to 6dB BER is 1 once reaching the 6dB its start to varying BER and its reaches 20.1dB the BER goes to 0. When Eb/N0 value increases BER is decreases. So QAM achieve low BER compare to 8-QAM and 16-QAM in AWGN channel.

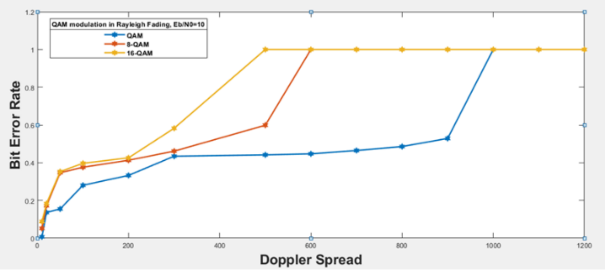

Figure 8. BER v/s Doppler Spread of QAM in Rayleigh Fading channel.

In Rayleigh fading channel PSK modulation as lower BER compare to QAM with respect to Eb/N0 value. But compare to in terms of Doppler Spread QAM as higher than the PSK.

In Rician fading having higher Doppler spread compare to Rayleigh fading, but lower BER. In Rician fading also QPSK gives lower BER compare to 8-PSK and 16-PSK. In Rician fading channel also we taken lower transmission velocity to higher transmission velocity. The vehicular velocity in Rician fading varies from 5kmph to 1028kmph, 565kmph and 514kmph with respect to QPSK, 8-PSK and 16-PSK due to higher Doppler spread.

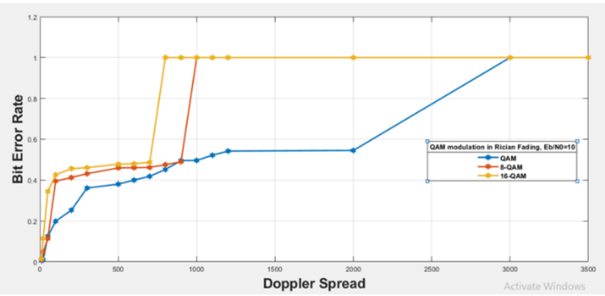

Figure 9. BER v/s Doppler Spread of QAM in Rayleigh Fading channel.

VI. CONCLUSION

We simulated Rayleigh and Rician fading channel models in our car environment for the likelihood of error. The simulation results show that the amount of fading in the signal shell increases with the speed of the vehicle of the user. Thus, the signal goes further down the threshold as the speed increases, and the fading rate increases. We use also the LabVIEW Simulation in the signal obtained for Doppler Spread and compare the values to those analytically determined to model the Rayleigh and Rician fading channels with respect to the probability of failure. In simulation and analysis, however, the results are comparable. Due to the presence of a view on Ricans, the BER in the fading channel is lower in Ricans compared with Rayleigh's fading channel. We have found that with increasing mobile or Doppler speed, the likelihood of an error increases. Dynamically changed multipath and Doppler effects are the leading causes of the degradation of channel capacity. Nevertheless, we would like to develop a generic mobile communication (vehicle applications) model in future communications. AWGN channel, Rayleigh channel and Rician Fading channel based upon BER evaluate various digital modulation systems, including PSK and QAM. Rayleigh's performance is the worst of all channels. Rician channel performance is worse than the performance of the AWGN channel and better than the performance of the Rayleigh fading channel. The faded Rician channel has more BER than the AWGN channel and less than the Rayleigh fading channel through LabVIEW simulations.

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