Performance Analysis of BPSK & 8-FSK Modulation Technique through AWGN Channel in Wireless Communication System

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ABSTRACT

BPSK and 8-FSK modulation techniques are used in a variety of wireless communication systems. It has a substantial impact on wireless communication channels. The significance of analyzing and comparing the performance of these two modulation techniques over the AWGN fading channel cannot be overstated. This research can be used to determine the best technique for implementing in an AWGN fading channel. To investigate the performance of BPSK and 8-FSK modulation schemes on an AWGN channel in order to calculate the error rate quantity, and to provide a solution in such cases by providing a simple programmable interface for error rate calculators and switching between different techniques using channel block-sets. The performance analysis is carried out by utilizing the MATLAB Simulink software to synthesize the design. A simulated comparative result is shown using the AWGN channel to analyze the performance of these systems. The results clearly show that the BPSK modulation technique outperforms the 8-FSK modulation technique over the AWGN channel.

Keywords: AWGN, BPSK, Channel Error rate, 8-FSK, Performance analysis

1 Introduction

Digital modulation techniques provide more information- carrying capacity, data security with better quality communication. BPSK & FSK modulation techniques enable systems to improve data transmission rate within the same available channel bandwidth. Both modulators enable systems to improve data transmission and can modulate adequate transmission rate gain but it needs a suitable and accurate architecture to counteract varying channel conditions. BPSK is largely a Double Side Band Suppressed Carrier DSBSC modulation theme, for the message being the digital information. Wherever the zero (0) and one (1) during a binary message as two totally different phases sets within the carrier signal [1]. During this technique, the carrier signal takes two-phase reversals like 0° and 180° BPSK is employed on each carrier and that they are often severally demodulated and a group of basic functions is chosen for a specific modulation theme [2].

Frequency Shift Keying (FSK) is that the most used technique of digital modulation within the high-frequency spectrum is principally utilized in mobile circuits, over lines with display (where the caller's range is displayed). Frequency-shift keying is that the same as employing a binary digital signal to modulate the FM carrier [1]. It's conjointly used once sending low-frequency radio signals within the terribly low and intensely low-frequency bands, moreover as automatic meter reading [3]. In frequency-shift keying, the frequency of a carrier signal is shifted from a mark frequency (for example, causing a binary 1) to a space- frequency (sending a binary 0), in keeping with the baseband digital signal [1].

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These modulation techniques used to find the bit error rate characteristics of the receiver are evaluated by using MATLAB. This would mean higher clarity of voice, message, and the multimedia signal can transmit with higher accuracy of data over the wireless medium. An important issue in wireless application development is the selection of fading models & channels. In this paper, the AWGN channel is used between transmitter and receiver which compared and analyze the bit error rate by using the MATLAB environment [5].

Reliable communication at R bits/symbol means that codes at that rate can be designed with an arbitrarily low error probability. To achieve dependable communication, one should code over an extended block; this can be to take advantage of the law of large numbers to average out the randomness of the noise. Replication of coding does not pack the code words efficiently within the available degrees of freedom in Associate. Within the block length, one can fit a variety of code words that are exponentially long and still communicate faithfully. This means that when dependableness is increased arbitrarily by increasing block length, the information rate will be strictly positive. It is possible to pack an exponential number of code words per block length and still communicate reliably. This means that the data rate can be strictly positive while increasing the block length to double dependability in every way. The utmost rate at that reliable communication is feasible is termed the capacity C of the channel. The capacity of the (real) AWGN channel with power constraint P and noise variance is maintaining the integrity of the specifications and the engineering problem of constructing codes close to this performance has been successfully addressed. So, the additive white Gaussian noise channel capacity can be written as-

$$C_{awgn} = \frac{1}{2}\log(1+\frac{P}{\sigma^2}) \quad \text{............ (1)}$$

In the equation the signal to noise ratio plays a pivotal role in AWGN channel capacity. The error rate output calculation depends on the capacity of the AWGN channel. The signal to noise ratio and input power has been recognized as study parameters which has been varied. Other parameters are kept constant for that performance analysis. The study explores some interesting characteristics of these two modulation techniques.

2 Modeling Block Using MATLAB Simulink

The simulation models of the modulation channel have been described for BPSK & FSK is the most popular digital modulation techniques. A Bernoulli Binary Generator has been applied as input into the digital modulation techniques for BPSK & FSK. Performance of BPSK & FSK digital modulation schemes is analyzed for AWGN channel. Fig. 1 depicts a BPSK modulation and demodulation setup. In this case, the model investigated the properties of BPSK modulation in relation to an additive white Gaussian noise (AWGN) channel. A display probe was connected to test the error calculation of that modulation technique. Similarly, in Fig. 2, a connection was shown for analyzing the characteristics of the FSK modulation technique with respect to the AWGN channel.

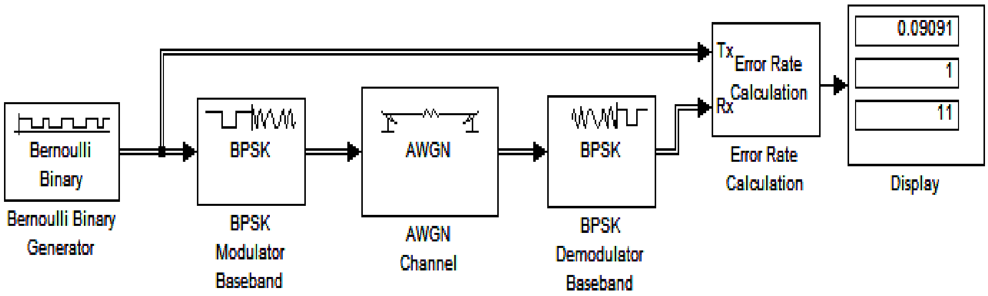

Fig. 1 BPSK Modulation for AWGN Channel.

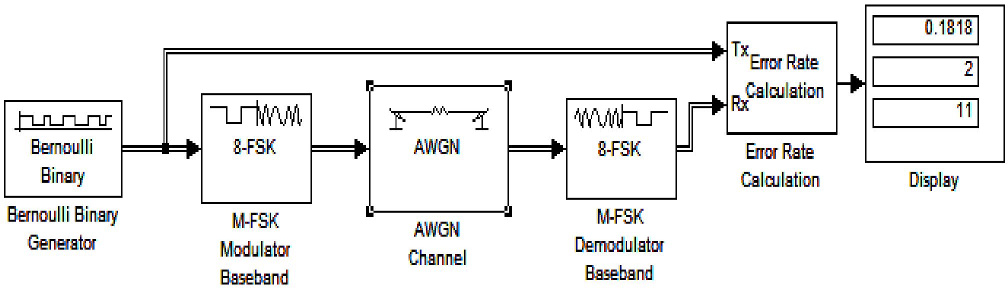

Fig. 2 FSK Modulation Schemes for AWGN Channel.

3 Results and Discussion

Using MATLAB Communication Simulink blocks for modeling the modulation process performance by using the following block parameter showing in table I. The table I expresses the input parameter values that has been taken for analysis of the performance.

TABLE I. INPUT PARAMETER VALUES OF THE MATLAB COMMUNICATION SIMULINK BLOCK

Name of the Block	Name of the Parameter	Parameter Values
Bernoulli Binary Generator	Probability of a Zero	0.1
	Initial Seed	61
	Sample Time	1
	Sample per Frame	1
	Output data type	Double.
MFSK Modulator Baseband	M-ary Number	8
	Input Type	Integer
	Symbol Set Ordering	Binary
	Frequency Separation (Hz)	6
	Samples per symbol	17
AWGN	Initial Seed	67

Channel	Mode	Signal to noise ratio (Eb/No)
	Eb/No (dB)	1 to 10 (dB)
	Number of bits per symbol	1
	Input signal power(in watt)	1
	Symbol period(s)	1
BPSK Modulator Baseband	Phase offset(rad)	0
	Output Data type	Double
BPSK Demodulator Baseband	Decision Type	Hard Decision
	Phase offset (rad)	0
	Output Data type	Double
	Data Type	Inherit: Same word length as input
M-FSK Demodulator Baseband	M-ary Number	8
	Output Type	Integer
	Symbol Set Ordering	Binary
	Frequency Separation (Hz)	5
	Samples per symbol	17
	Output data type	Double
Error Rate Calculation	Receive Delay	0
	Computation Delay	0
	Computation Mode	Entire frame
	Output Data	Port

In table II the performance of 8-FSK modulation has been analyzed by taking the input power as 1 Watt as reference. The Signal to Noise Ratio of AWGN channel was varied and the error rate calculation output was measured in each case. When the system reaches the 10 dB signal to noise ratio it shows almost zero error rate. That means the 8-FSK demonstrates better result when SNR of an AWGN channel reaches at or above 10dB.

TABLE II. 8-FSK in AWGN Channel (SNR is Variable)

Sl. No.	SNR (dB)	Error Rate Output
01	1	0.6364
02	2	0.6364
03	3	0.5455
04	3.5	0.4545
05	4	0.3636
06	4.5	0.2727
07	5	0.1818
08	5.5	0.09091
09	9	0.09091
10	10	0

In table III the signal to noise ratio has been considered as 5dB to analyze the effect of varying the input power of the signal. In this study that is evident that if the signal increases the error rate output also increases. But if it is greater than 5 watts the error output has been found constant. The 8-FSK modulation demonstrates that lesser input power generates lesser error output. It shows some constant values of error rate output between the input power in 2-3, 4-5 and 6-10 watts. From 6-10 watts it exhibits higher error rate than previous input powers.

TABLE III. 8-FSK in AWGN Channel (SNR is Constant)

Sl. No.	Input Signal Power (Watts)	Error Rate Output
01	1	0.1818
02	2	0.6364
03	3	0.6364
04	4	0.7273
05	5	0.7273
06	6	0.8182
07	7	0.8182
08	8.5	0.8182
09	9	0.8182
10	10	0.8182

In table IV the performance of BPSK modulation has been examined by taking the input power as 1 Watt constant. The variation of signal to noise ratio has been varied as the same data observed in the 8-FSK modulation technique. The observation demonstrates that after 2dB signal to noise ratio the error rate output tends to zero and remain constant to that.

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TABLE IV. BPSK in AWGN Channel (SNR is Variable)

Sl. No.	**SNR (dB)**	**Error Rate Output**
01	1	0.09091
02	2	0.09091
03	3	0
04	3.5	0
05	4	0
06	4.5	0
07	5	0
08	5.5	0
09	9	0
10	10	0

In table V it states that for BPSK modulation technique when the signal to noise ratio has been kept constant at 5dB and input signals varied the increase in input shows the increase in output error rate. The error rate sometimes constant input powers between 2-4 watts, 6-7 watts and 8.5-10 watts.

TABLE V. BPSK in AWGN Channel (SNR is Constant)

Sl. No.	**Input Signal Power (Watts)**	**Error Rate Output**
01	1	0
02	2	0.09091
03	3	0.09091
04	4	0.09091
05	5	0.1818
06	6	0.2727
07	7	0.2727
08	8.5	0.3636
09	9	0.3636
10	10	0.3636

From the above data to compare the results between 8-FSK and BPSK modulation techniques two output curves has been generated. In Fig. 3 the signal-to-noise ratio vs. error rate output curve has been exhibited. The output curves demonstrates that 8-FSK modulation technique has greater error output rate than BPSK modulation technique in AWGN channel.

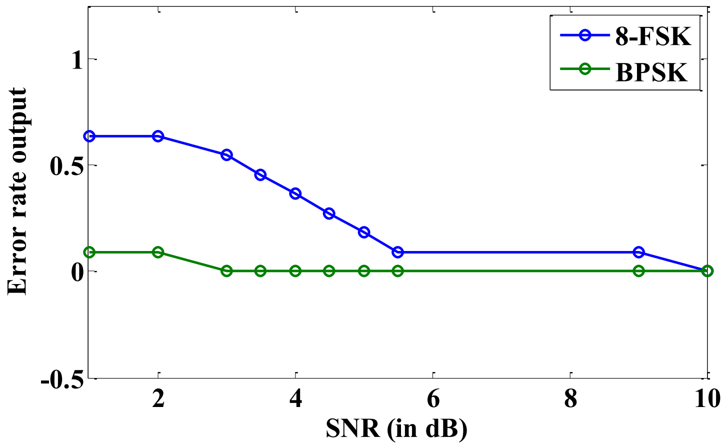

Fig. 3 Signal-to-noise ratio vs. error rate output curve.

In Fig.4 the input power vs. error rate output curve has also been shown. In this curve it is evident that the error rate output of 8-FSK modulation technique is greater than BPSK modulation technique in AWGN channel.

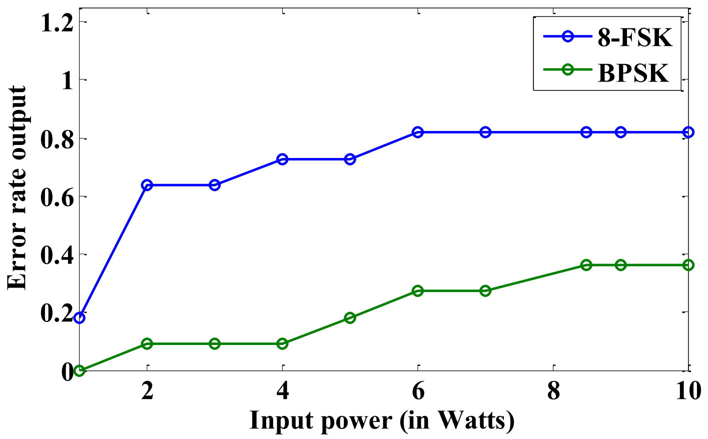

Fig. 4 Input power vs. error rate output curve.

4 Conclusion

It is critical in digital communication to overcome the fading of the wireless channel. The modulation techniques 8-FSK and BPSK are considered in this performance analysis. The additive white Gaussian noise fading channel is a type of fading that can be found in the majority of wireless channels. To examine the effects of modulation technique on error rate output, two parameters are used: signal-to-noise ratio and input power. The error rate output results clearly show that the BPSK modulation technique is far more compatible than the 8-FSK modulation technique in the additive white Gaussian noise (AWGN) fading channel.

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