Available online at www.pelagiaresearchlibrary.com

Pelagia Research Library

Advances in Applied Science Research, 2011, 2 (4):521-527

Comparative BER Performance of PSK based modulation Techniques under Multipath Fading

Vikas Chauhan, Manoj Arora and R. S. Chauhan

Department of Electronics & Communication, J. M. I. T, Radaur, Haryana (India)

ABSTRACT

This project studies and identifies the PSK-based digital modulation scheme (BPSK, QPSK or GMSK) that gives the best BER performance in a multipath fading environment using computer simulation (MATLAB). Each PSK-based digital modulation are modeled and simulated under different channel conditions. Subsequently, a comparison study is carried out to obtain the BER performance for each PSK-based transmission scheme under 1-path and 4-path multipath fading conditions and to identify which modulation scheme gives best BER performance. The comparison study showed that BER for BPSK and QPSK are similar and they give the lowest BER under multipath fading. Nonetheless, GMSK's BER is just slightly higher than that of BPSK and QPSK.

Keywords: BER, BPSK, GMSK, Fading, QPSK.

INTRODUCTION

The growing demands for voice and multimedia services on mobile wireless communication spur the advancement of the wireless communication field in the recent decade. One of the major underlying technologies is the digital modulation technique which allows digitized data to be carried or transmitted via the analog radio frequency (RF) channels. Digital modulation techniques contribute to the evolution of our mobile wireless communications by increasing the capacity, speed as well as the quality of the wireless network. This paper concentrates on PSK modulation techniques in which a finite number of phases are used to represent digital data. This paper concentrates on PSK modulation techniques in which a finite number of phases are used to represent digital data. Digital modulation schemes have greater capacity to convey large amounts of information than analog modulation schemes.The modulation formats here consider are Binary phase shift keying(BPSK)[1] due to its simplicity ,Quadrature phase shift keying(QPSK)[2] and Gaussian minimum shift keying(GMSK)[3] due to its importance for

current mobile and cordless communication systems such as GSM[4].The comparative bit error rate performance of different PSK based modulation techniques under multi path fading is studied to get best results by removing obstacles and reflectors in wireless propagation channel.

System Modelling

Ideal channel-Additive White Gaussian Noise (AWGN) Channel

In constructing a mathematical model for the signal at the input of the receiver, the channel is assumed to corrupt the signal by the addition of white Gaussian noise as shown in Figure 1 below, therefore the transmitted signal, white Gaussian noise and received signal are expressed by the following equation with *s(t),n(t)* and *r(t)* representing those signals respectively[8]:

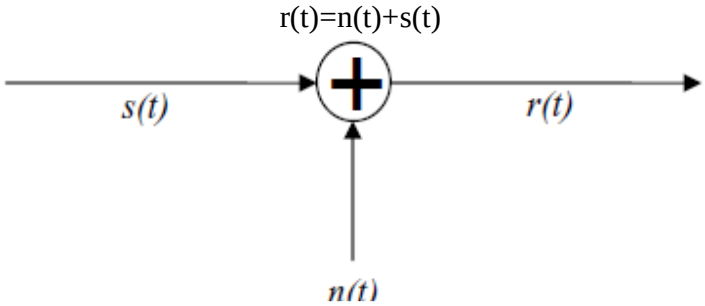

Figure 1 Received signal corrupted by AWGN

Where *n(t)* is a sample function of the AWGN process with probability density function (pdf) and power spectral density as follows:

$$\Omega_{nm}\text{f}=\frac{1}{2}N_0\left[\frac{w}{H_z}\right]$$

Where *N0* is a constant and called the noise power density[7].

Worst Case Channel – Multipath Fading Channel

As shown in the model above, the path between base station and mobile stations of terrestrial mobile communications is characterized by various obstacles and reflections. The radio wave transmitted from the base station radiates in all directions. These radio waves, including reflected waves that are reflected off of various objects, diffracted waves, scattering waves, and the direct wave from the base station to the mobile station[9]. Therefore the path lengths of the direct, reflected,diffracted, and scattering waves are different, the time each takes to reach the mobile station is different. The phase of the incoming wave also varies because of the reflection. As a result, the receiver receives a superposition consisting of several waves having different phase and time of arrival[4]. Multipath fading raises the error rate of the received data. Finally here these two channels are modeled and simulated by implementing MATLAB software[10]. The first channel is an idealistic channel with only additive white Gaussian noise and the second channel is a practical model of the communication channel in an urban environment where signals are being reflected, thus arriving at the receiver's end at different time and phase[5].

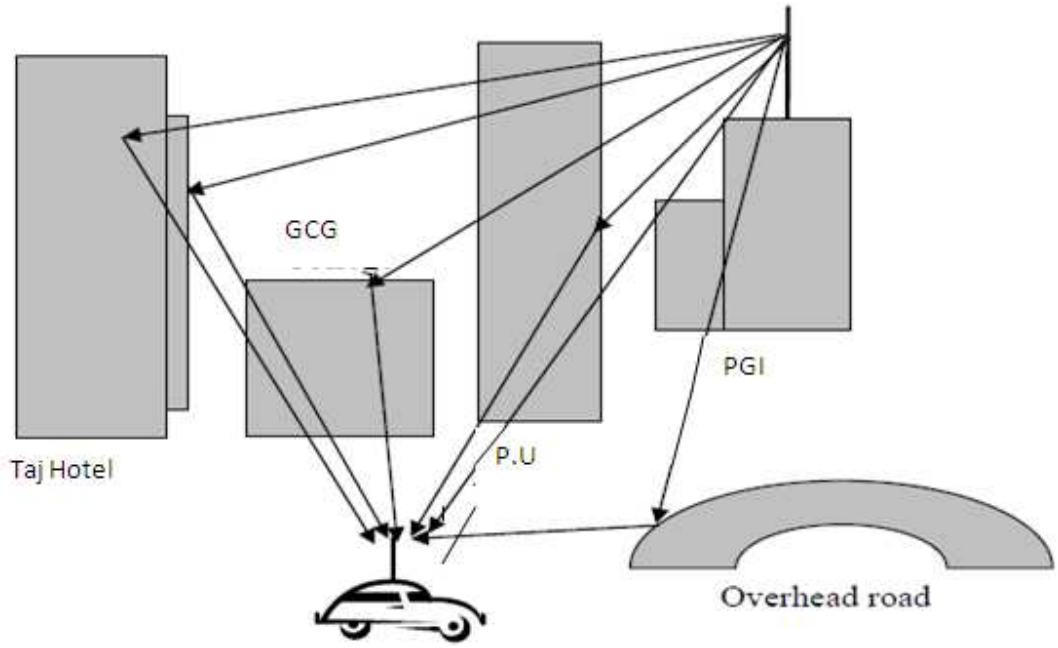

Figure 2 PGI junction in Chandigarh

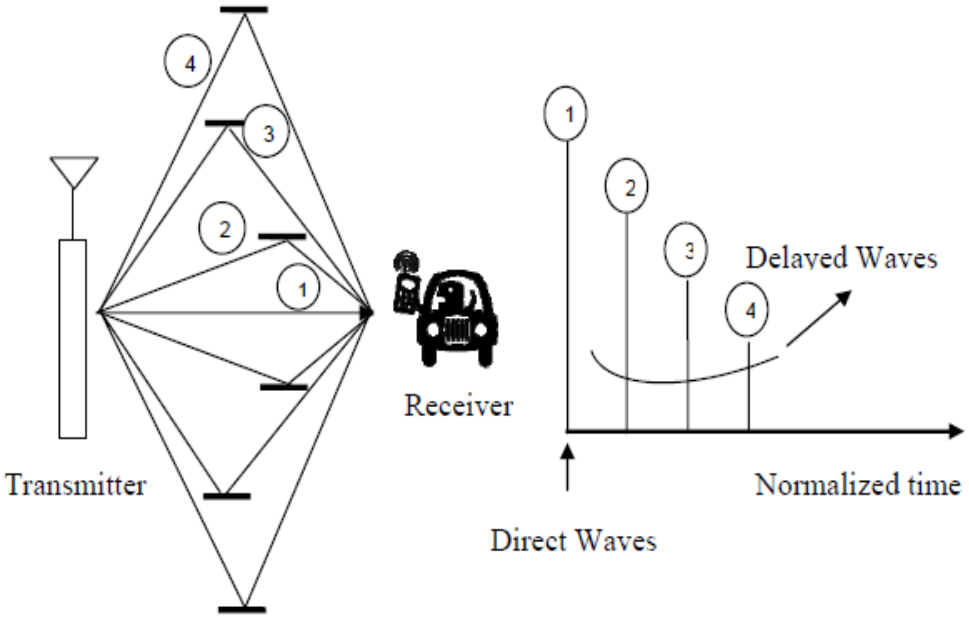

Figure 3 Configuration of multipath fading channel

In simulating multipath fading environment, only the relative signal level and relative delay time of the delayed waves need to be given in comparison with the direct wave . The flowchart is shown as follows figure 4:

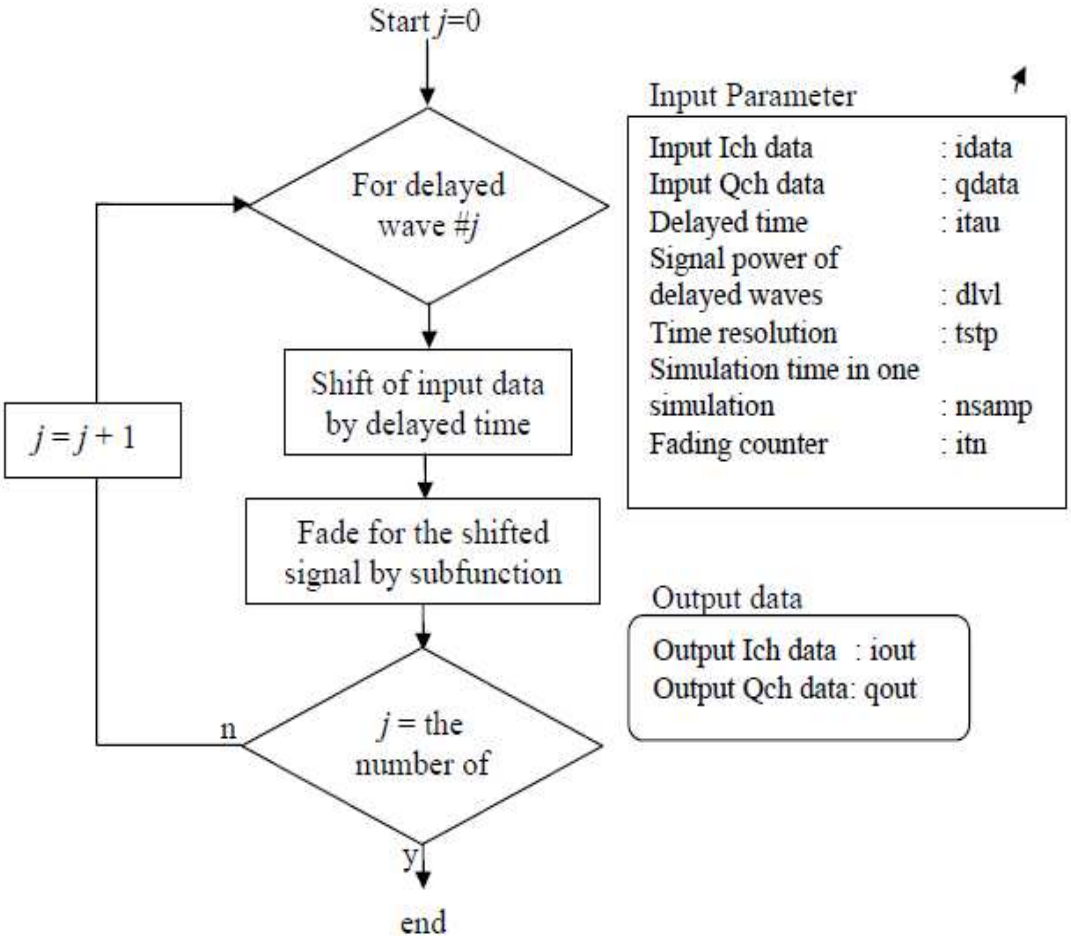

Figure 4 Flowchart to obtain multipath fading channel[6]

RESULTS AND DESCUSSION

Comparison Results of BPSK, QPSK and GMSK under Same Channel Communication Channel Conditions

In comparing the performance of the three PSK based transmission undersame channel conditions, three graphs are obtained one for each channel condition.

(a) AWGN Channel

BPSK and QPSK obtained similar result. Comparing their theoretical BER for AWGN equation, they are identical. Hence this result is correct. Even so, it can be observed that BPSK requires less signal power to obtain a 0 BER. GMSK BER performance is significantly higher than BPSK. This might be due to the Gaussian filtering.

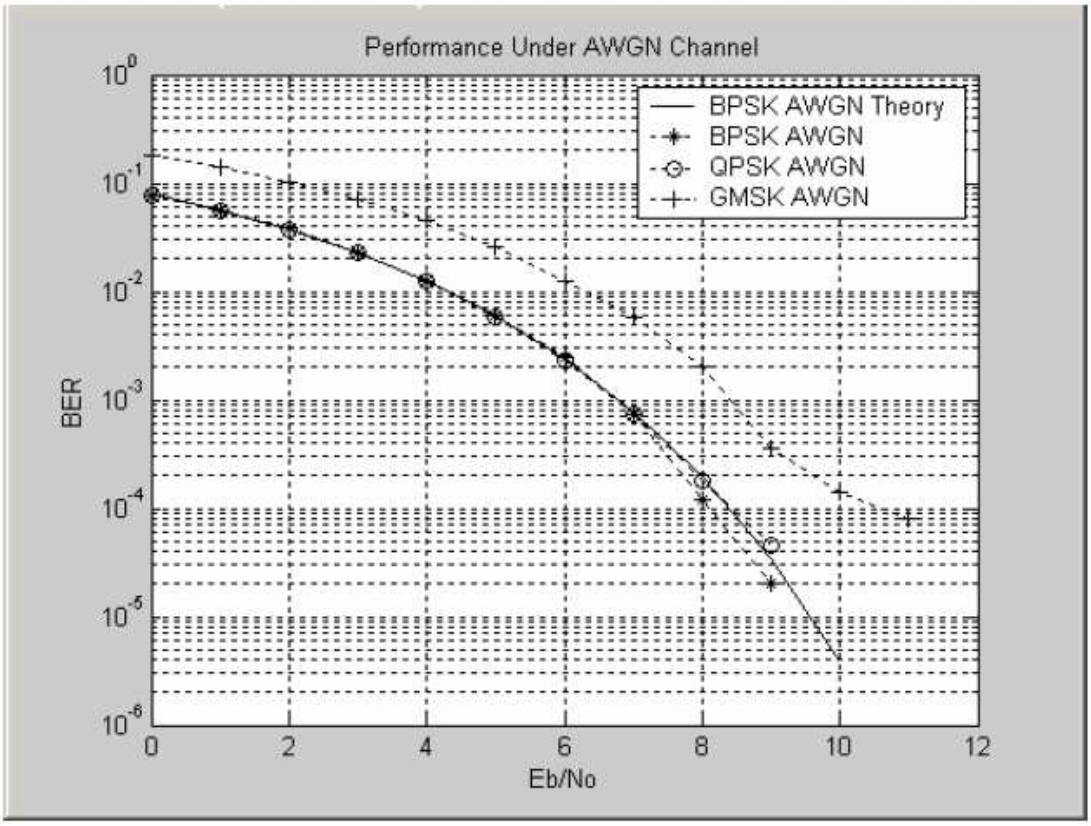

Figure (a) A comparison graph for AWGN channel for BPSK, QPSK & GMSK transmission schemes

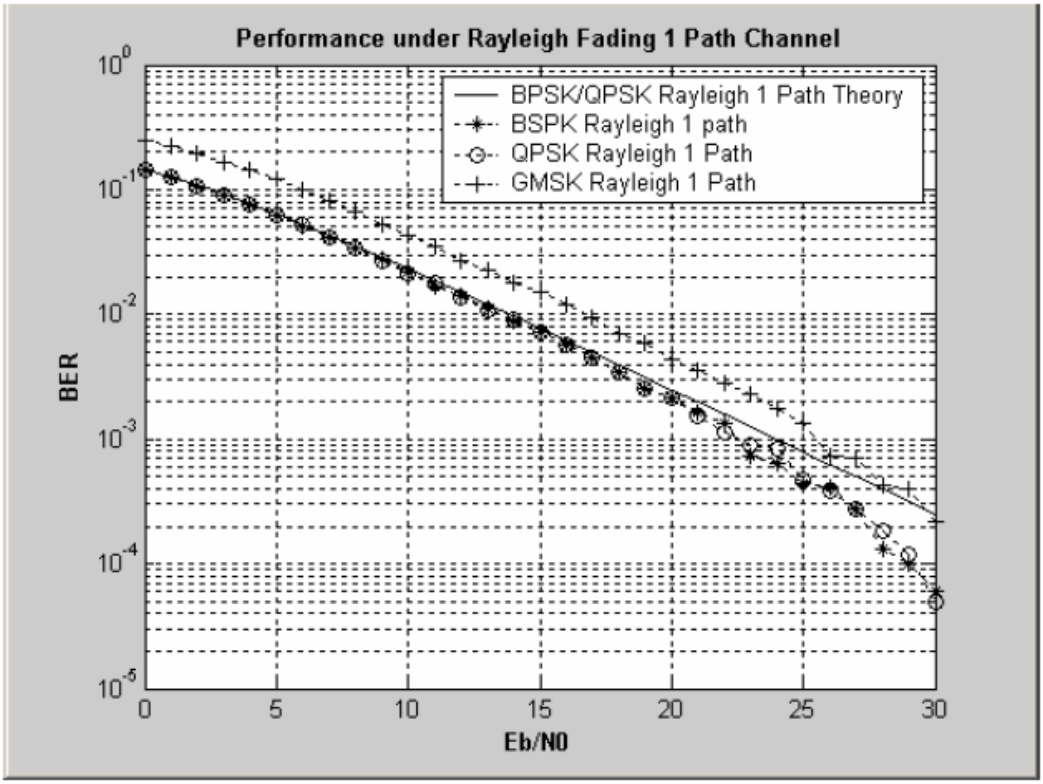

Figure (b) A comparison graph for 1-path Rayleigh channel for BPSK, QPSK & GMSK transmission schemes

(b) One-Path Fading Channel

Once more, BPSK and QPSK obtained similar result with BPSK requiring less signal power to obtain a 0 BER than QPSK. Comparing their theoretical BER for 1-path fading equation, they are identical[11]. Hence this result is correct. GMSK BER performance is again significantly higher than BPSK. This might be due to the Gaussian filtering.

(c) Four-Path Fading Channel

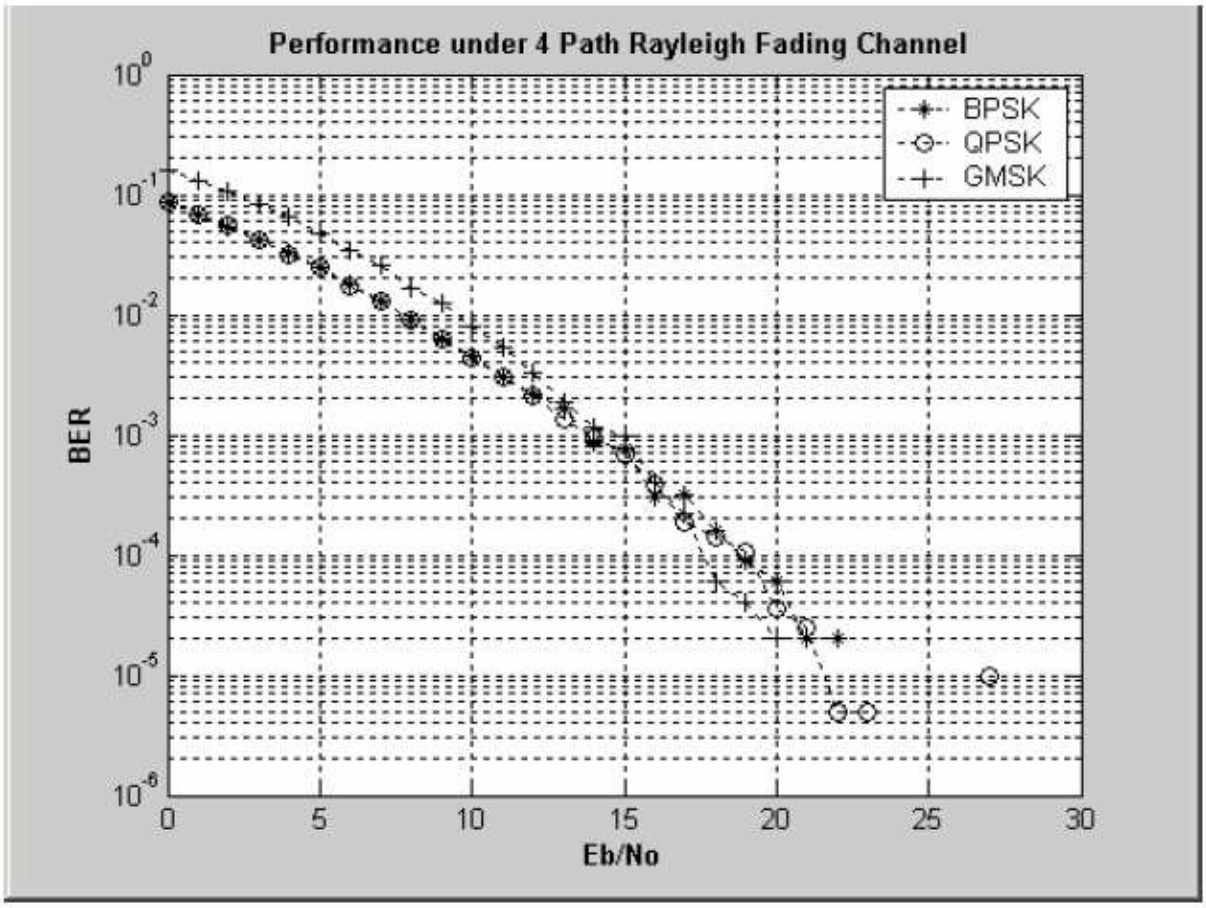

Figure (c) A comparison graph for 4-path Rayleigh channel for BPSK, QPSK & GMSK transmission schemes

BPSK and QPSK obtained similar result with BPSK requiring less signal power to obtain a 0 BER than QPSK. GMSK BER performance is slightly higher than BPSK/QPSK and at higher E_b/N_0 (>15dB), the BER is slower than both BPSK and QPSK. This might the reason why GMSK is chosen to be the standard in GSM or it might due to the inaccuracy of the simulation program.

CONCLUSION

- BER for BPSK and QPSK are similar except a 0 BER can be obtain for BPSK at a lower E_b/N_0 (I .e lower signal power).

- BER obtained for all PSK schemes under 4-Path Rayleigh Fading Channel are lower than the 1-Path Rayleigh Fading Channel.
- BER obtained for GMSK is higher compared to BER obtained for BPSK and QPSK but at higher E_b/N_0 , the BER for GMSK is lower than both BPSK and QPSK.

REFERENCES

[1] O.Fonseca and I.N.Psaromiligkos, *Electronics Letters*, Sep. **2006**, 42, 20
[2] U.H. Rizvi,G.J.M. Janseen and J.H.Webber. BER analysis of BPSK and QPSK constellations in the presence of ADC quantization noise. *Proceeding of APCC 2008*, **2008**.
[3] K.Murota,K.Hirade. *IEEE Trans. Comm.,july,* **1981**, 29, 1044-1050.
[4] M.K. Simon, M.S. Alouini. *Digital Communication over Fading Channels: A Unified Approach to Performance Analysis* Copyright. **2000,** John Wiley & Sons, Inc.
[5] Proakis, J.G. Digital Communications, 3rd ed., NY: Mcgraw-Hill, **1995**.
[6] Hiroshima Harada, Ramjee Prasad, Simulation & Software Radio for Mobile communication, 71-164, **2002**
[7] Lawrence Harte, Richard Levine, Roman Kikta, 3G Wireless Demystified: Mcgraw-Hill, **2002**.
[8] Dr Pao Lo Lui, Comparison of Single Carrier and Multi-carrier (OFDM) PSK transmission schemes in Multi-path Wireless channel
[9] Sampei, S., Applications of Digital Wireless Technologies to Global Wireless Communications, Upper Saddle River, NJ: Prentice Hall, **1997**
[10] Prasad, J. G., Digital Communications, 3rd Edition., New York: McGraw Hill, **1995**
[11] Jakes, W.C., Microwave Mobile Communications, NewYork:IEEE Press