PERFORMANCE ENHANCEMENT OF OFDM SYSTEM IN AWGN AND RICIAN CHANNEL BY USING OPTIMIZE ADAPTIVE CODING TECHNIQUE

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Abstract*— Orthogonal Frequency Division Multiplexing (OFDM) is Basic Element in 4G mobile system. In many communication systems, OFDM is extensively useful to reduce the bandwidth and for its enhancement ability of the data rate. Performance of OFDM improved by using different channel coding through Additive white Gaussian noise (AWGN) and Rician Channel. In this paper we analyzed BER (Bit error rate) performance of 4 PSK; higher order modulators such as16-QAM, 64-QAM System over AWGN and Rician Channel by using convolutional coding. In OFDM system, at receiver the Signal to noise ratio is estimated and then transmitted to the transmitter through feedback channel, the transmitter according to the estimated SNR select appropriate modulation scheme and coding rate which maintain constant bit error rate lower than the requested BER. Simulation is carried out on the software named MATLAB.

***Index Terms*— OFDM, AWGN, Rician, BER, SNR, Channel Coding.**

I. INTRODUCTION

During the past few years, there has been an explosion in wireless technology. This growth has opened a new dimension to future wireless communications whose ultimate goal is to provide universal personal and multimedia communication without regard to mobility or location with high data rates. Orthogonal Frequency Division Multiplexing (OFDM) is one of the promising candidates to mitigate the ISI. In an OFDM signal the bandwidth is divided into many narrowband channels. [1]

Orthogonal frequency-division multiplexing (OFDM) is a method of encoding digital data on multiple carrier frequencies. OFDM has developed into a popular scheme for wideband digital communication, whether wireless or over copper wires, used in applications such as digital television and audio broadcasting, DSL Internet access, wireless networks, power line networks, and 4G mobile communications. OFDM is essentially identical to coded OFDM (COFDM) and discrete multi-tone modulation (DMT), and is a frequency-division multiplexing (FDM) scheme used as a digital multi-carrier modulation method. The word "coded" comes from the use of forward error correction (FEC). A large number of closely spaced orthogonal sub-carrier signals are used to carry data on several parallel data streams or channels. Each sub-carrier is modulated with a conventional modulations scheme (such as Quadrature amplitude modulation or phase-shift keying) at a low symbol rate, maintaining total data rates similar to conventional single-carrier modulation schemes in the same bandwidth.[9] The performance of knowledge transmission over wireless channels is well captured via looking at their BER, which is a function of SNR on the receiver. Orthogonal frequency division multiplexing (OFDM) has been commonly adopted and implemented in wire and wireless conversation, similar to digital subscriber line (DSL), digital terrestrial TV broadcasting (DVB-T), IEEE 802.11a wireless local field networks (WLANs) and European excessive efficiency nearby discipline network (HIPERLAN/2).[5]

II. SYSTEM MODELS

The sub band adaptive transmission schemes are employed to reduce the complexity. In sub band adaptive OFDM transmission, all subcarriers in an AOFDM symbol are split into blocks of adjacent subcarriers referred to as sub bands. The same mode is employed for all subcarriers of the same sub band. The choice of the modes to be used by the transmitter for its next OFDM symbol is determined by the channel quality estimate of the receiver based on the current OFDM symbol. Perfect channel estimation is assumed in this paper. In this simulation the instantaneous SNR of the subcarrier is measured at the receiver. The channels quality varies across the different subcarriers for frequency selective channels. The received signal at any subcarrier can be expressed as. [9]

Rn =HnXn+Wn

Where Hn is the channel coefficient at any subcarriers, Xn is the transmitted symbol and Wn is the Gaussian noise sample. So the instantaneous SNR can be calculated using

$$\mathrm{SNHn} = \frac{\mathrm{Hn}^2}{\mathrm{N0}}$$

The conservative approach in threshold based adaptation is by using the lowest quality subcarrier in each sub band for controlling the adaptation algorithm. It means that the lowest value of SNR will be used in mode selection. By using this method, the overall BER in one sub band is normally lower than the BER target. If the overall BER can be Optimize adaptive coding technique to improve performance of OFDM system closer to the BER target by choosing a more suitable modulation mode or code rate, the throughput of the system will be higher.

Therefore a better adaptation algorithm is used in this paper to provide a better tradeoff between throughput and overall BER by choosing a more suitable scheme for each sub band. Instead of using the lowest SNR in each sub band, the average value of the SNR of the subcarriers in the sub band is going to be used. [1]

Figure (1) shows the adaptation procedure

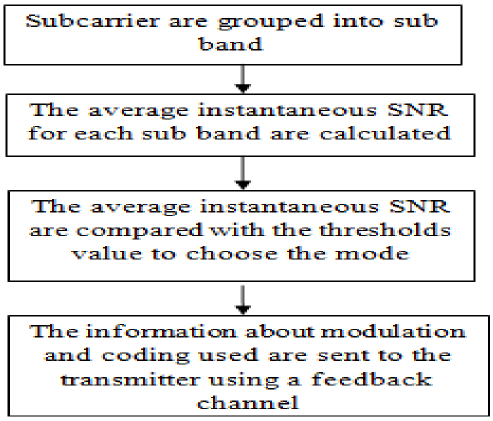

Fig. 1: Adaption Procedure [9]

III. BLOCK DIAGRAM OF OFDM SYSTEM

The block diagram of this system is shown in Figure 2. The channel estimation and mode selection are done at the receiver side and the information is sent to the transmitter using a feedback channel. In this model the adaptation is done frame by frame. The channel estimator is used to estimate the instantaneous SNR of the received signal. Based on the instantaneous SNR calculated, the best mode will be chosen for the next transmission frame. This task is done by the mode selector block. At the transmitter the adaptive modulator block consists of different modulators which are used to provide different modulation modes. The switching between these modulators will depend on the instantaneous SNR. This block diagram is used to describe two types of adaptive modulation schemes which is based on MQAM and MPSK scheme. [9].

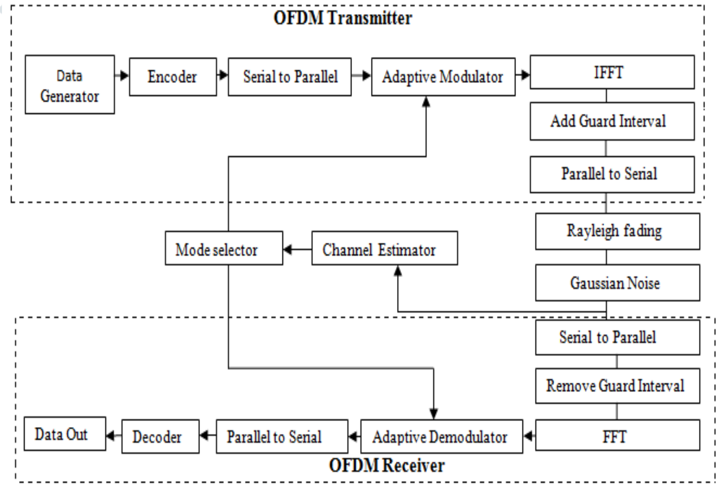

Fig. 2: Block diagram of OFDM system [9]

IV. SIMULATION RESULTS

A. Convolutional coding with AWGN PSK

Fig.3 shows the BER performance of QPSK over AWGN channel with convolutional coding. BPSK requires 3 dB less of signal to noise ratio than QPSK to achieve the same BER. This outcome will hold true only if we consider BER in terms of SNR per carrier. In terms of signal to noise ratio per bit the BER is same for both QPSK and BPSK. The effects of AWGN channel simulated in Matlab. The results are displayed in Fig.3.

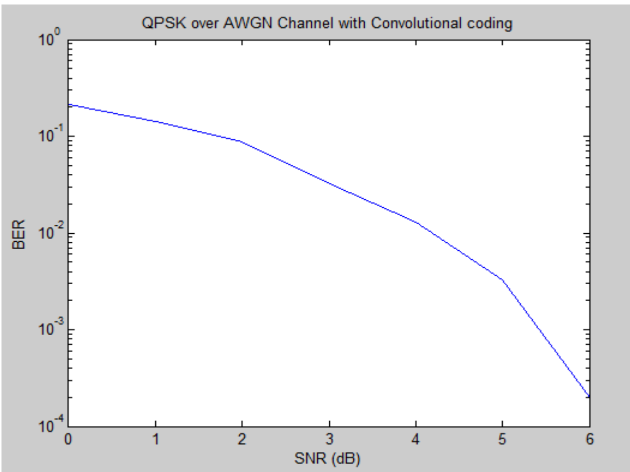

Fig. 3: QPSK over AWGN channel with convolutional coding

B. Convolutional coding with AWGN QAM

Fig.4 shows the 16-QAM over AWGN Channel with convolutional coding. It represent the matlab result of the signal to noise ratio verses Bit error rate performance. In 16-QAM over AWGN Channel with convolution coding of signal to noise ratio is increases the bit error rate is decreases. Fig 5 shows 64-QAM over AWGN channel with Convolutional coding.

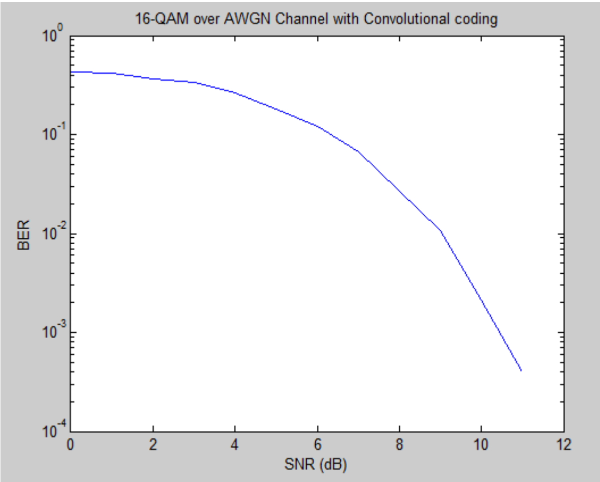

Fig. 4: 16-QAM over AWGN Channel with Convolutional coding

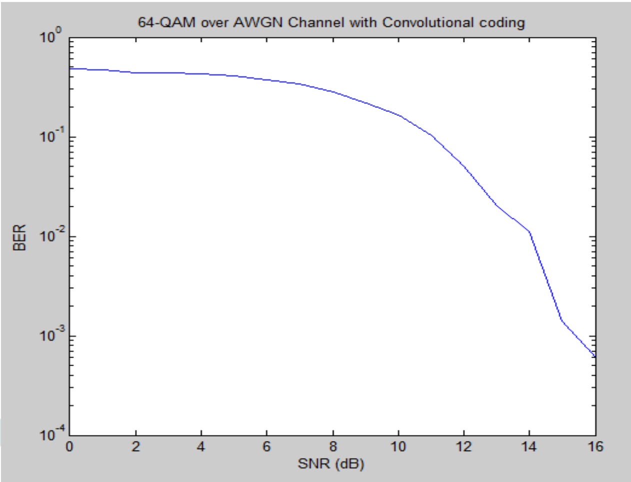

Fig. 5: 64-QAM over AWGN Channel with Convolutional coding

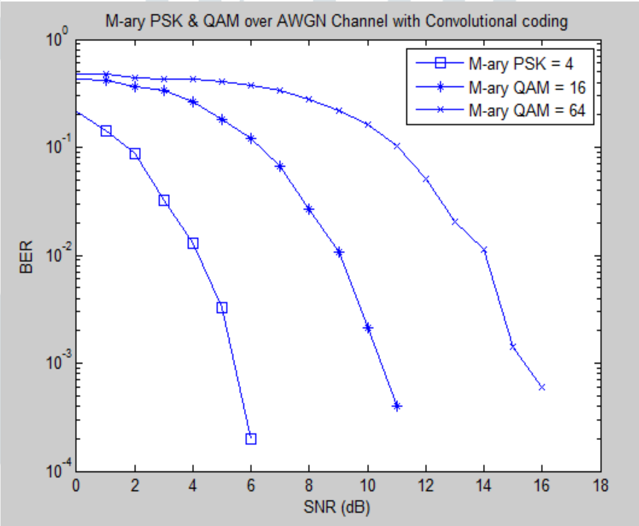

Fig. 6: M-ary PSK & QAM over AWGN Channel with convolutional coding

C. Convolutional coding with Adaptive AWGN Channels

Fig.7 shows the MATLAB result of PSK & QAM adaptive modulation over AWGN Channel with Convolutional coding. In MATLAB the PSK and QAM signal are adaptive by using adaptive modulation and display the result as shown in Fig.7

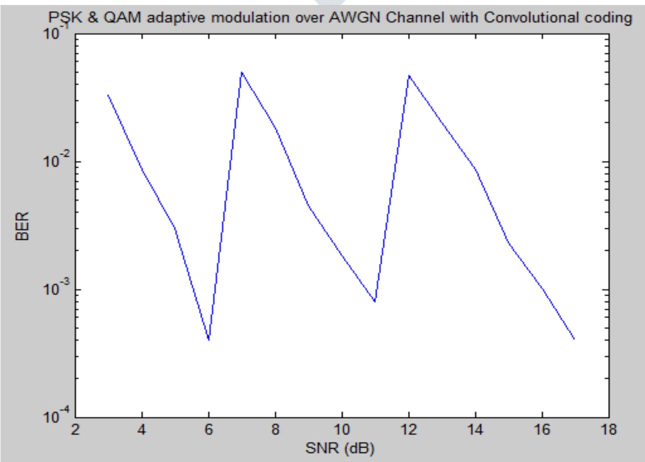

Fig. 7: PSK & QAM adaptive modulation over AWGN Channel with Convolutional coding

D. Convolutional Coding Result with AWGN Channels

Fig.8 shows the MATLAB result of Adaptive PSK & QAM over AWGN Channel with Convolutional coding. In MATLAB the PSK and QAM signal are adaptive by using adaptive modulation and MATLAB gives this result are as shown in Fig. This figure indicates the Adaptive combination of Adaptive PSK and QAM. In an OFDM system using lower order modulators such as BPSK, 4-QAM and 8-QAM will improve BER but decreases spectral efficiency, on the other hand employing higher order modulators such as 64 QAM, 128 QAM, 256QAM and 512 QAM will increase spectral efficiency but result in poor BER. So to achieve good trade-off between spectral efficiency and overall BER adaptive modulation is used.

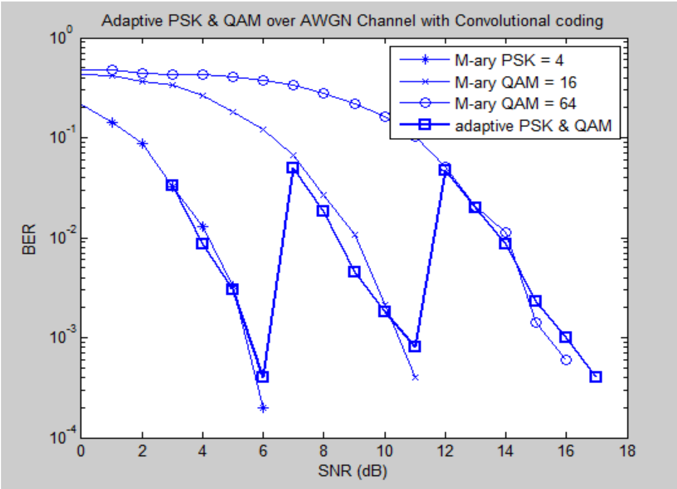

Fig. 8: Adaptive PSK & QAM over AWGN Channel with Convolutional coding

E. Convolutional coding with Rician PSK

Fig. 9 shows the BER performance of QPSK over Rician channel with convolutional coding. BPSK requires 3 dB less of signal to noise ratio than QPSK to achieve the same BER. This outcome will hold true only if we consider BER in terms of SNR per carrier. In terms of signal to noise ratio per bit the BER is same for both QPSK and BPSK. The effects of Rician channel simulated in Matlab.

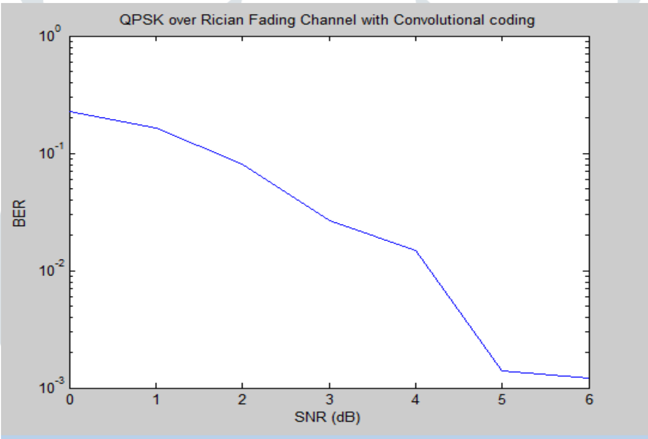

Fig. 9: QPSK over Rician Channel with Convolutional Coding

F. Convolutional coding with Rician QAM

Fig.10 shows the 16-QAM over Rician Fading Channel with convolutional coding. It represent the matlab result of the signal to noise ratio verses Bit error rate performance. In 64-QAM over Rician Fading Channel with convolutional coding of signal to noise ratio is increases the bit error rate is decreases. Fig.11 shows 64-QAM over Rician Fading channel with Convolutional coding.

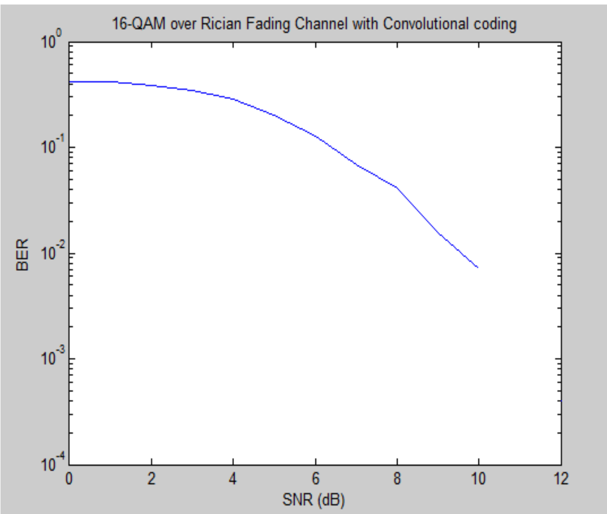

Fig. 10: 16-QAM over Rician Channel with Convolutional Coding

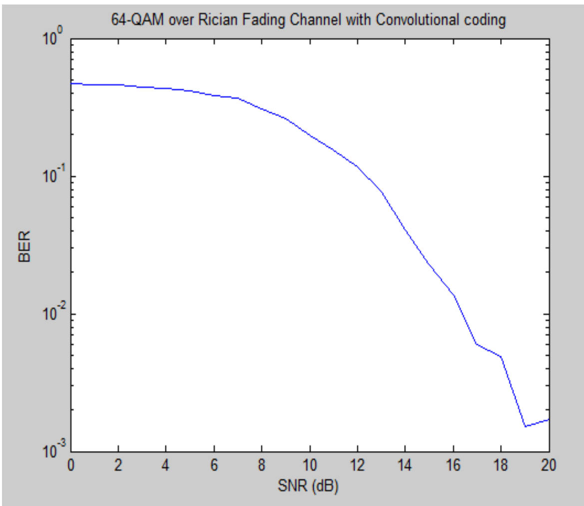

Fig. 11: 64-QAM over Rician Channel with Convolutional Coding

Fig.12 shows M-ary PSK & QAM over Rician Channel with convolutional coding. This figure shows the combination of M-ary 4-PSK, M-ary 16-QAM and M-ary 64-QAM.

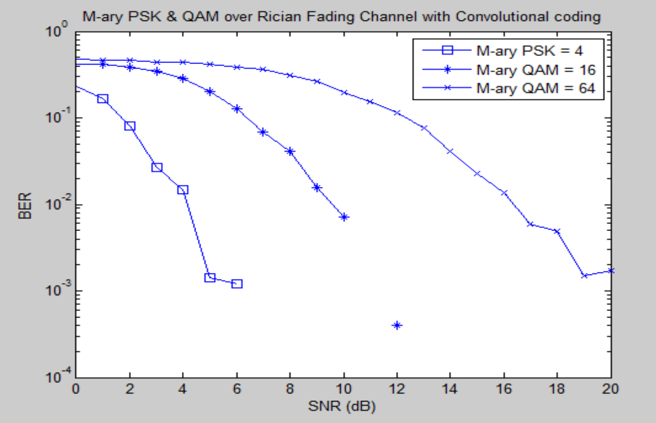

Fig. 12: PSK & QAM adaptive modulation over Rician Channel with Convolutional Coding

G. Convolutional coding with Adaptive Rician Channels

Fig.13 shows the MATLAB result of PSK & QAM adaptive modulation over Rician Fading Channel with Convolutional coding. In MATLAB the PSK and QAM signal are adaptive by using adaptive modulation and display the result as shown in Fig.13

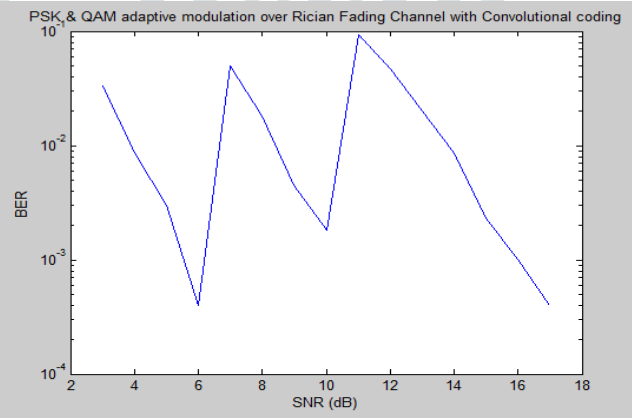

Fig. 13: PSK & QAM adaptive modulation over Rician Channel with Convolutional Coding

H. Convolutional Coding Result with Rician Channels

Fig. 14 shows the MATLAB result of Adaptive PSK & QAM over Rician Fading Channel with Convolutional coding. In MATLAB the PSK and QAM signal are adaptive by using adaptive modulation and MATLAB gives this result are as shown in Fig. 13. This figure indicates the Adaptive combination of Adaptive PSK and QAM. In an OFDM system using lower order modulators such as BPSK, 4-QAM and 8-QAM will improve BER but decreases spectral efficiency, on the other hand employing higher order modulators such as 64 QAM, 128 QAM, 256QAM and 512 QAM will increase spectral efficiency but result in poor BER. So to achieve good trade-off between spectral efficiency and overall BER adaptive modulation is used. Fig. 13 shows the simulated BER performance of M-ary PSK, 16-QAM, 64-QAM and adaptive modulation scheme for an OFDM system over AWGN channel. The goal of the adaptive modulation algorithm we used in our simulation is to reach and maintain a target BER irrespective of the SNR levels that each individual subcarrier experiences.

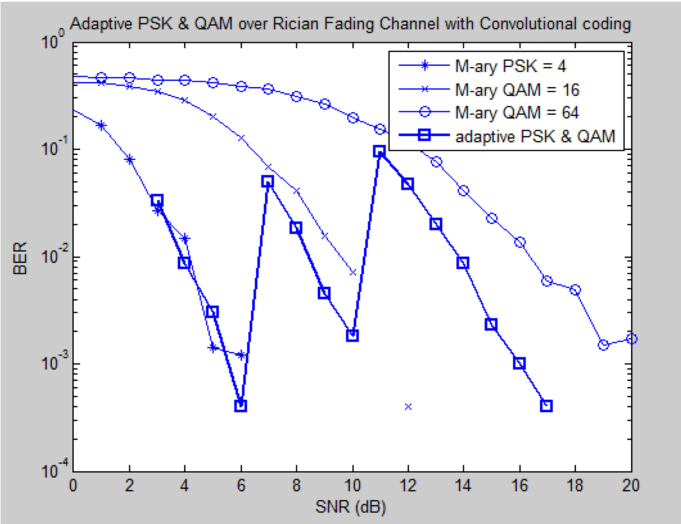

Fig. 14: Adaptive PSK & QAM over Rician Channel with Convolutional Coding

V. Conclusion

The detail knowledge of a current key issue in the field of communications named Orthogonal Frequency Division Multiplexing (OFDM). In this paper the performance of OFDM in AWGN and Rician Channel is evaluated, with comparative performance between PSK and QAM modulation schemes under AWGN and Rician channels have been conducted. From the study of the system, it can be concluded that we improve the performance of uncoded OFDM by convolution coding scheme. The performance of Rician channel is worse than that of AWGN channel; Because Rician fading channel has higher BER than AWGN channel.

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