EVALUATION OF OFDMA'S PERFORMANCE ACROSS DIFFERENT CHANNEL

Gaurav Prakash Sawant[1], Manoj Prasad[2]

[1]PG Scholar, E&TC Dept.,   SVCET Rajuri, India.

[2]Asst. Professor, E&TC Dept, SVCET Rajuri, India.

ABSTRACT

The fastest-growing sector of the communication industry is wireless communications. Mobile communication is the most popular type of wireless communication. However, there are a lot of technological obstacles to be solved. A wireless channel's signal may experience propagation path loss, interference, fading, and shadowing, among other issues. The high caliber service always results in a higher demand for capacity. By transforming the wideband signal into narrow band signals for transmission, orthogonal frequency division multiplexing (OFDM), a well-defined method, is an appropriate choice for high band width data transmission in this scenario. These distinct narrow band signals are sent using orthogonal carriers.

MATLAB 19.1 has been used to simulate orthogonal frequency division multiplexing (OFDM). Simulink toolbox is used for simulation in MATLAB program. Bit Error Rate against Signal to Noise Ratio is used to assess transmission mode performance under two commonly used channel modes: Additive White Gaussian Noise and Rician Fading channel. We have displayed a graphical analysis of several OFDM quality of service metrics over AWGN, Rician fading channels in order to conduct further investigation. This paper's conclusion provides implementation details for OFDM across AWGN and Rician fading channels. Additionally, two distinct AWGN, Rician fading channels' QOS parameters were compared quantitatively and graphically.

Keywords: OFDMA, AWGN, Rician Channel, OFDM, Fading.

1. INTRODUCTION

The data in a rudimentary communication system are modulated onto one carrier frequency. Each symbol then takes up all of the available bandwidth. In the event of a frequency selective channel, this type of system may result in inter-symbol-interference (ISI). The fundamental principle of OFDM is to partition the available spectrum into several orthogonal sub-channels, resulting in almost flat fading for each narrowband sub-channel.

The transmission rate can be increased by using OFDM by having overlapping sub-channels in the frequency domain. In recent years, there has been a growing interest in OFDM systems. In 1970, the United States granted a patent for Orthogonal Frequency Division Multiplexing (OFDM), a unique type of multicarrier modulation (MCM) including overlapping spectra and subcarriers that are closely spaced. The use of steep band pass filters, which were common in older Frequency Division Multiplex (FDMA) systems (such as in analog SSB telephone trunks), Multi-Tone telephone modems, and Frequency Division Multiple Access radio, was abandoned by OFDM. These filters completely separated the spectrum of individual subcarriers. Rather, even if subcarrier spectra may overlap, mutual orthogonality is guaranteed by the selection of OFDM time-domain wave forms[1].

It seems that a Fast Fourier Transform at the transmitter and receiver could produce such waves. The concept seemed limited in its usefulness for a considerable amount of time. Implementation details like Aspects of implementation that seemed insurmountable included the intricacy of a real-time Fourier Transform, as well as the stability of oscillators in transmitters and receivers, the need for linearity in RF power amplifiers, and the resulting power back-off. After years of additional, intense research in the 1980s, it seems like MCM approaches are about to make a breakthrough. Many of the implementation issues seem to be fixable, and MCM is now included in a number of standards[2].

 The research and simulation of orthogonal frequency division multiplexing (OFDM) will be the main emphasis of this project. Because OFDM resists ISI, it is particularly well-suited for high-speed communication. Each transmission must necessarily take less time as communication devices speed up the flow of information. ISI becomes a barrier in high-data-rate transmission since the multipath-induced delay time is continuous. This issue is avoided by OFDM, which sends numerous low-speed broadcasts at once. As an illustration, Figure in 1
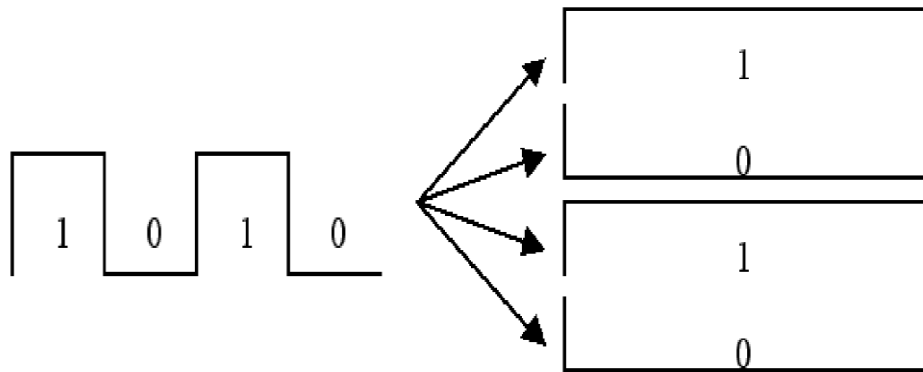
Figure 1. Traditional vs. OFDM communication

2. METHODOLOGY

Within the telecommunications industry, wireless communications is a quickly growing subset. One branch of communication that is utilized more widely is mobile communication. However, there are other difficulties that need to be researched, evaluated, and paid for. When a signal is delivered across a wireless channel, it must contend with issues like shadowing, propagation route loss, interference, and fading. Similar to wireless communication, high-quality service is constantly required.

The optimum communication method in this situation is orthogonal frequency division multiplexing (OFDM); OFDMA is a useful approach for large band width data communication; both techniques transform wideband signals into narrow band signals for communication. Every narrow band signal is transmitted using an orthogonal carrier.

3. LITERATURE REVIEW

The literature survey is carried out by different E-medias, IEEE journals, national and international conference paper-paper, research journals etc.

This paper **"MIMO Broadcasting for Simultaneous Wireless Information and Power Transfer"** investigates the performance limits of self-powered wireless networks by opportunistically harvesting energy from ambient radio signals. Under a simplified three node setup, this study reveals some fundamental tradeoffs in designing wireless multi-antenna systems for simultaneous information and power transfer. In particular, for the case of co-located energy and information receivers, it show a performance bound that cannot be achieved by existing technologies. Thus it is our hope that this work will motivate future research in this area to reduce or even close this gap. [3]

R. Zhang & C. K. Ho, "MIMO Broadcasting for Simultaneous Wireless Information and Power Transfer," IEEE Globecom 2011.

This paper **"Wireless Information and Power Transfer: Architecture Design and Rate-Energy Tradeoff"** investigates practical receiver designs for simultaneous wireless information and power transfer. Based on dynamic power splitting (DPS), this propose two practical receiver architectures, namely, separated and integrated information and energy receivers. For the separated receiver, the received signal by the antenna is split into two signal streams in the RF band, which are then separately fed to the conventional energy receiver and information receiver

for harvesting energy and decoding information, respectively. For the integrated receiver, part of the information decoding implementation, i.e., the RF to baseband conversion, is integrated to the energy receiver via the rectifier. For both receivers, this characterize the rate-energy performance taking circuit power consumption into account.

Numerical results show that when the circuit power consumptions are small (compared with the received signal power), the separated receiver is superior at low harvested energy region; whereas the integrated receiver performs better at high harvested energy region. When the circuit power consumptions are large, the integrated receiver is superior. Moreover, the performance for the two types of receivers is studied under a realistic system setup that employs practical modulation. With symbol error rate constraint and minimum harvested energy constraint, the maximum achievable rates by the two types of receivers are compared. It is shown that for a system with zero-net-energy consumption, the integrated receiver achieves more rate than separated receiver at small transmission distances. [4]

X. Zhou, R. Zhang, and C. K. Ho, "Wireless information and power transfer: architecture design and rate-energy tradeoff," IEEE Trans. Commun., vol. 61, no. 11, pp. 4754–4767, Nov. 2013.

This paper **"Robust Beamforming for Wireless Information and Power Transmission"**

consider the worst-case robust beamforming design for the wireless communication system with both information and energy receivers when the CSI is imperfect. By means of semi definite relaxation, this transforms the original robust design problem into a SDP problem. Then this proves that such relaxation is tight and this can always obtain the optimal solution of the original problem. The performance of the proposed beamforming algorithm has been demonstrated by simulations. Future research directions may include the robust beamforming design for the more general broadcasting systems with multiple information receivers and multiple energy receivers. [5]

Z. Xiang and M. Tao, "Robust beamforming for wireless information and power transmission," IEEE Wireless Commun. Lett., vol. 1, no. 4, pp. 372–375, 2012.

This paper **"Multiuser MISO Beamforming for Simultaneous Wireless Information and Power Transfer"** has studied the joint information and energy transmit beamforming design for a multiuser MISO broadcast system for simultaneous wireless information and power transfer (SWIPT). The weighted sum-power harvested by EH receivers is maximized subject to individual SINR constraints at ID receivers. Considering two types of ID receivers without or with the interference cancellation capability, the design problems are formulated as two non-convex QCQPs, which are solved optimally by applying the techniques of SDR and uplink-downlink duality. The results of this paper provide useful guidelines for practically optimizing the performance of multi-antenna SWIPT systems with receiver-location-based information and energy transmission. [6]

J. Xu, L. Liu, and R. Zhang, "Multiuser MISO beamforming for simultaneous wireless information and power transfer," in Proc. 2013 IEEE Int. Conf. Acoust., Speech, Signal Process.

This paper **"Wireless Information and Power Transfer: A Dynamic Power Splitting Approach"** has studied simultaneous wireless information and power transfer (SWIPT) via the approach of dynamic power splitting (DPS). Under a point-to-point flat-fading SISO channel setup, this show the optimal power splitting rule at the receiver based on the CSI to optimize the rate-energy performance trade-off. When the CSI is also known at the transmitter, the jointly optimized transmitter power control and receiver power splitting is derived. The performance of

the proposed DPS in the SISO fading channel is compared with that of the existing time switching as well as a performance upper bound obtained by ignoring the practical circuit limitation. Furthermore, this extend the DPS scheme to the SIMO system with multiple receiving antennas and show that a uniform power splitting (UPS) scheme is optimal. This also investigate the practical antenna switching scheme and propose a low-complexity algorithm for it, which can be efficiently implemented to achieve the R-E performance closely to the optimal UPS as the number of receiving antennas increases. [7-9]

4. PERFORMANCE ANALYSIS

Following mathematical expressions are used to calculate the SNR (signal-to-noise ratio), Bit rate, SER (symbol error rate), BER (bit error rate) for AWGN & Rician channel.

1) $\text{SNR} = 10 \log_{10} \left(\frac{Ps}{Pn} \right) \text{ dB}$

2) $\text{Bit Rate} = \frac{\text{No. of error}}{\text{Total no. of bit send}} \text{ Mb/}$

3) $\text{BER} = \frac{1}{2} \text{erfc} \left(\sqrt{\frac{Eb}{No}} \right) \% \quad \&$

4) $\text{SER} = \frac{1}{2} \text{erfc} \left(\sqrt{\frac{Es}{No}} \right) \%$

In this project, graphical analysis is used to compare performance of OFDM over two different channels. Graphical results are as follows:

Graph no. 1:

This figure 1 shows the graph of real time SNR (in db) plot for AWGN & RICIAN Channel. It shows the spectrum for both the channels from 1 to 1500 sample values.
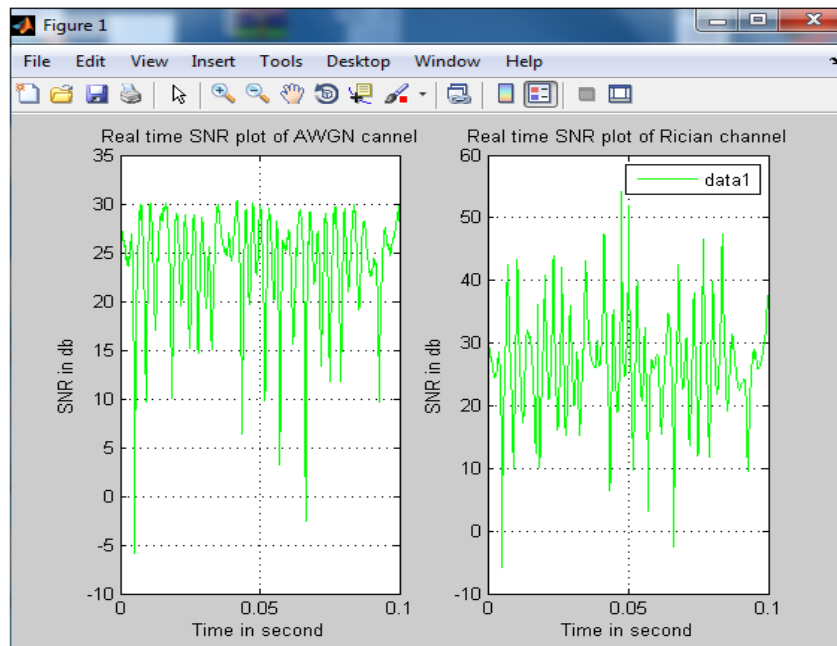
2. Figure 6. Real time vs. SNR plot for AWGN & RICIAN channel

5. CONCLUSION

MATLAB was used in this study to testify for and evaluate the suggested system. Multiple quality parameters are used to evaluate the system for two distinct channels, AWGN and Rician channels. A comparative study reveals that in terms of received power, packet loss, signal to noise ratio, symbol error rate, bit error rate, and other factors, Rician channel performs better than AWGN channel. It is discovered that the suggested method works well in terms of reduced packet loss and improved received power in both channels without inter-symbol interference. The analysis is predicated on a study of both graphical and quantitative analysis of quality of service criteria. Describe the transmitter and receiver ends of the OFDM system's operation as well as its design and implementation. Here, the Inter Symbol Interference (ISI) is eliminated using a cyclic prefix addition technique. The model's functionality is confirmed by simulation, and the system's performance is assessed under real-world operating conditions. We discovered that the OFDM model outperforms traditional systems in terms of performance. Furthermore Finally, we use a graph to wrap up our work. The quantitative and graphical examination of the OFDM technique's quality of service metrics over two distinct AWGN, Rician fading channels reveals that

6. REFERENCES

[1] R. Zhang and C. K. Ho, "MIMO broadcasting for simultaneous wireless information and power transfer," IEEE Trans. Wireless Commun., vol. 12, no. 5, pp. 1989–2001, May 2013.

[2] L. R. Varshney, "Transporting information and energy simultaneously," in Proc. 2008 IEEE Int. Symp. Inf. Theory, pp. 1612–1616.

[3] [3] X. Zhou, R. Zhang, and C. K. Ho, "Wireless information and power transfer: architecture design and rate-energy tradeoff," IEEE Trans. Commun., vol. 61, no. 11, pp. 4754–4767, Nov. 2013.

[4] [4] Z. Xiang and M. Tao, "Robust beamforming for wireless information and power transmission," IEEE Wireless Commun. Lett., vol. 1, no. 4, pp. 372–375, 2012.

[5] H. Ju and R. Zhang, "A novel mode switching scheme utilizing random beamforming for opportunistic energy harvesting," in Proc. 2013 IEEE Wireless Commun. Netw. Conf.

[6] J. Xu, L. Liu, and R. Zhang, "Multiuser MISO beamforming for simultaneous wireless information and power transfer," in Proc. 2013 IEEE Int. Conf. Acoust., Speech, Signal Process.

[7] L. Liu, R. Zhang, and K. C. Chua, "Wireless information transfer with opportunistic energy harvesting," IEEE Trans. Wireless Commun., vol. 12, no. 1, pp. 288–300, Jan. 2013.

[8] L. Liu, R. Zhang, and K. C. Chua, "Wireless information and power transfer: a dynamic power splitting approach," IEEE Trans. Commun., vol. 61, no. 9, pp. 3990–4001, Sep. 2013.

[9] S. Timotheou, I. Krikidis, and B. Ottersten, "MISO interference channel with QoS and RF energy harvesting constraints," in Proc. 2013 IEEE Int. Conf. Commun.