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STUDY PAPER ON WIRELESS MIMO-OFDM SYSTEM USING MODULATION WITH COMMUNICATION CHANNEL

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ABSTRACT

Today, communication has become an integral part of our lives and the past 10 years witnessed various innovations in the mobile telephony. The demand for data services also increased. The main need of any communication system is basically high speeds of data transmission with higher accuracy and reliability. Multiple input multiple output (MIMO) provides high-rate transmission through expended channels by multiple array antennas on both sender and receiver side. Also orthogonal frequency division multiplexing (OFDM) is well-known as the most appropriate technique for high data rate transmission. In this paper, we propose a multi-user multiple-input multiple-output (MIMO) orthogonal frequency division multiplexing (OFDM) system with adaptive modulation and coding to improve system capacity with maintaining good error performance.

Keyword: MIMO, OFDM, Wireless, Modulation, Channel.

INTRODUCTION

The key challenge faced by future wireless communication systems is to provide high-data-rate wireless access at high quality of service (QoS) [3]. Wireless Communication Wireless communication is the use of EM waves to transfer data between two users. Wireless communications has developed into a key element of modern society. From satellite transmission, radio and television broadcasting to the now ubiquitous mobile telephone, wireless communications has revolutionized the way societies function [26].

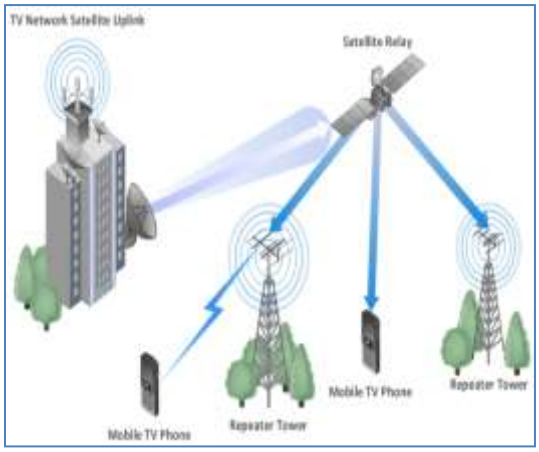

Fig. 1: Wireless-Network-Diagram

It has many advantages over the earlier successful wired communication. These are its portability, flexibility and coverage.[9] Like any communication system, a wireless communication system is made up of the three fundamental blocks:

1. Transmitter 2. Receiver 3. Channel.

When two people are conversing the person who has to convey a message (transmitter) has to turn it into words and speak. The recipient (receiver) on receiving the speech signals decodes the words and interprets the message. It is difficult for the recipient to guess the message when the environment (channel) is noisy. The success rate of

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deciphering the message depends on loudness of the speaker, ear sensitivity of the recipient, and his intelligence to guess it.[9]

INTRODUCTION OF OFDM

Orthogonal Frequency-Division Multiplexing (OFDM) has emerged as a successful air-interface. In the case of wired environments, OFDM techniques are also known as Discrete Multi-Tone (DMT) transmissions and being used in Asymmetric Digital Subscriber Line (ADSL), High-bit-rate Digital Subscriber Line (HDSL), and Very-high-speed Digital Subscriber Line (VDSL).

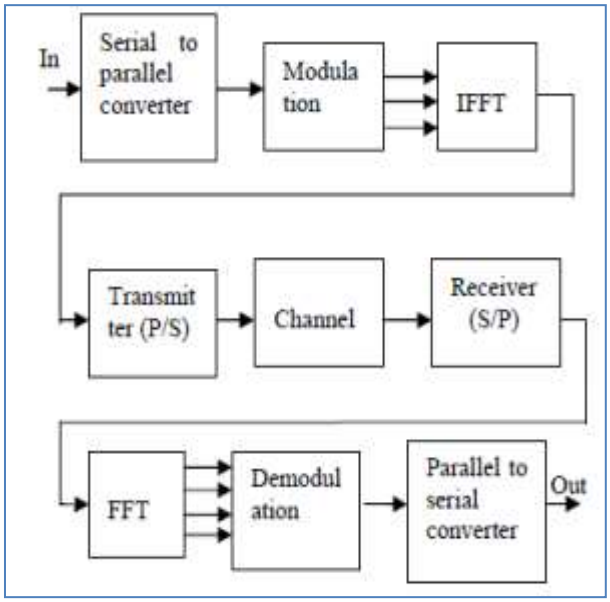

Fig. 2: Basic OFDM System

A. Advantages of OFDM systems are:

- High spectral efficiency.
- Simple implementation by fast Fourier
- Transform. Low receiver complexity.
- Suitability for high-data-rate transmission over
- Low-complexity multiple access schemes such
- Orthogonal frequency-division multiple access (OFDMA).

B. Disadvantages of OFDM systems

- Higher peak-to-average power ratio (PAPR).
- compared to single-carrier modulation.
- Sensitivity to time and frequency.

MIMO SYSTEM

MIMO (multiple input, multiple output) brief: - In 1998 Bell Laboratories successfully demonstrated the MIMO system under laboratory conditions. In the following years Gigabit wireless Inc. and Stanford University developed a transmission scheme and jointly held the first prototype demonstration of MIMO. MIMO is an antenna technology for wireless communications in which multiple antennas are used at both the source (transmitter) and the destination (receiver) [1]. Traditionally, SISO systems are used in wireless communication systems. The disadvantage of SISO systems is that the capacity cannot be increased unless more spectrum or transmit power is used.[4]. Normally, for communication one pair of transmitting and receiving antenna called as single input single output (SISO) is used. It

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cannot serve for high data rate services because of single antenna at both ends of the link. To mitigate this, MIMO system is used.[4] Single user MIMO communication systems exploit multiple transmit and receive antennas to improve capacity, reliability, and resistance to interference. Here I describe some of the research directions that my research group has taken in the general area of single user MIMO communication, with some select publications, and a brief summary of our key results. Some specialized topics like limited feedback communication are described in separate pages. Only select journal publications are mentioned here; more journal publications and conference papers may be found on my CV[12].

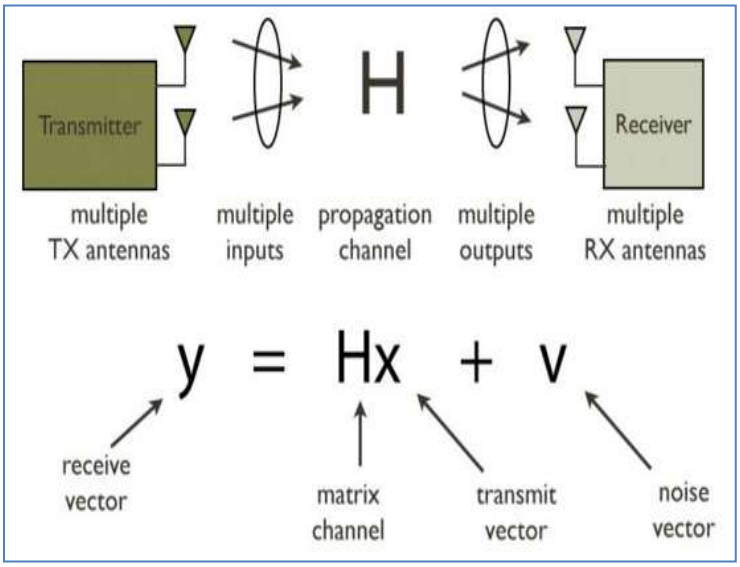

Fig. 3: MIMO-Communication Single User MIMO

MIMO-OFDM SYSTEM

In an OFDM-based MIMO system, spatial multiplexing is performed by transmitting independent data streams on a tone-by-tone basis with the total transmit power split uniformly across antennas and tones.[3] Multiple-input, multiple-output orthogonal frequency-division multiplexing (MIMO-OFDM) is the dominant air interface for 4G and 5G broadband wireless communications. It combines multiple-input, multiple-output (MIMO) technology, which multiplies capacity by transmitting different signals over multiple antennas, and orthogonal frequency-division multiplexing (OFDM), which divides a radio channel into a large number of closely spaced sub channels to provide more reliable communications at high speeds. Research conducted during the mid-1990s showed that while MIMO can be used with other popular air interfaces such as time-division multiple access (TDMA) and code-division multiple access (CDMA), the combination of MIMO and OFDM is most practical at higher data rates. [2]

In present day's communication, OFDM is a widespread and one of the most promising modulation techniques. It is beneficial in many areas such as high spectral efficiency, robustness, low computational complexity, frequency selective fading, and ease of implementation using IFFT/FFT and equalization schemes. Recently, there has been a lot of interest to use OFDM in combination with a MIMO transceiver system, named MIMO OFDM system [6]

In a MIMO-OFDM transmission system, each subcarrier is attenuated individually under the frequency selective and fast fading channel. The channel performance may be highly fluctuating across the subcarriers and varies from symbol to symbol [7]. If the same fixed transmission scheme is used for all MIMO-OFDM subcarriers, the error probability is dominated by the MIMO-OFDM Subcarriers with highest attenuation resulting in a poor performance. Therefore, in case of frequency selective fading the error probability decreases very slowly with increasing average signal-to-noise ratio (SNR) [7]

CONCLUSION

Performance of both SISO-OFDM and AMIMO-OFDM is described in this paper. MIMO-OFDM is a powerful modulation technique used for high data rate, and is able to eliminate ISI. It is computationally efficient due to the use of FFT techniques to implement modulation and demodulation functions.

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