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Secured Image Transmission Using MIMO-OFDM Technique

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Abstract **— In modern wireless communication system, MIMO (Multiple Input, Multiple Output)-OFDM (Orthogonal Frequency Division Multiplexing) is an air interface using dominantly. In order to achieve high speed data transfer, greatest spectral efficiency with increase in capacity and data throughput, we used MIMO-OFDM with M-QAM for lossless transmission and chaos encryption is implemented for security purpose in image transmission. MIMO and OFDM are needed to overcome frequency selective fading in narrowband system. The 16-QAM, 64QAM and 128QAM are extensively used to increase the rate of transmitted bits. Modulation and encryption techniques have been modified now. The use of chaos is becoming very common because of its various advantages in the encryption. It is very sensitive to primary conditions. In this manuscript, we have obtained the reliability analysis of grey scale image transmission with security shown in terms of signal to noise ratio in various values of decibels. Chaos provides more security and MIMO-OFDM is gives efficient transmission, that saves data bits from hacks and reduces transmission loss. This method can be implemented efficiently in many scenarios, mostly in the places where the information has to be transmitted confidentially and data bits should be very hard to find by third-party. MIMO-OFDM can be used for modulating, multiplexing and to achieve increase in data rates. By secrecy transmission, anonymous receiver cannot hack the information easily.**

Keywords **–** *(MIMO-OFDM, M-QAM, Chaos Encryption, Logistic Mapping, Anti-eavesdropping)*

I. INTRODUCTION

In fast technological evolution of digital information transfer in communication fields, information security becoming most important factor in data transmission. Since it is done wired manner, it has issues like lack of mobility, high cost for wires and its damages etc. Nowadays, wireless has been used to increase in data rates by decreasing those symbol periods. To overcome ISI problem even high speed data transfer, a concept known as OFDM (Orthogonal Frequency Division Multiplexing) modulation has been introduced. This paper deals with QAM (Quadrature Amplitude Modulation) for increasing the bit rates and Chaos encryption part to protect confidential information from third party access.

The results of software implementation of this concept in MATLAB are shown further. This has extended the uses of Chaos in several other applications. This paper proposes block diagram based on MIMO-OFDM that can be used to improve data rates with low ISI and chaos for security purposes.

The method of chaos encryption follows the XOR operation is performed for transforming values of image pixels or bits. By XOR operation, it is impossible to do reverse operation without knowledge of its initial value. This paper also includes of how the source image is encrypted by an encryption key and the data included additionally are hided into this encrypted image.

We proceeded with Section II, Section III and Section IV.

II. PROPOSED TECHNIQUE

The MIMO-OFDM implemented for lossless high speed data rate transmission and Chaos is used for encrypting the source/user transmitting image by masking its original

pixel values with our threshold values. The tested input image in MATLAB software shown below:

Fig. 1: Input gray scale image

Table: I Characteristics of Cameraman Test Image

Property	Value
Original Image Size	1024 x 1024
Total Pixels	1048576
Each Pixel Data Size	8-bits
For QPSK Transmission Size of Source Signal Data or Signal Elements	8388608/2 = 4194304
For 16-PSK / QAM Transmission Size of Source Signal Data or Signal Elements	8388608/4 = 2097152

Table: II MATLAB Simulation Parameters

Property	Value
Total Number of Sub-Carriers & FFT Size	**200**
Type of Guard Interval inserted after IFFT at Transmitter	Cyclic Prefix
Modulation Schemes	QPSK, 16-QAM,64-PSK,
	128-QAM
Channel	AWGN
Range of SNR in dB considered for evaluating BER	0 dB - 30 dB

III. EXPLANATION OF BLOCK DIAGRAM

This system consists of Chaos Encryption, OFDM modulation at transmitter side and AWGN (Additive White Gaussian Noise) channel with MIMO concept oriented transmission process and OFDM demodulation, Chaos Decryption at reception.

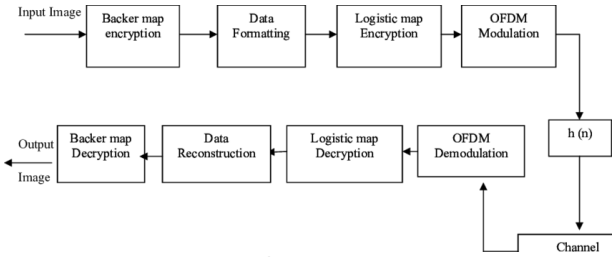

Fig. 2: System Diagram

A. Orthogonal Frequency Division Multiplexing (OFDM)

OFDM is a modern modulation technique which is mostly used in current scenario of wireless transmission to transmit various forms of digital information such as images in an effective way by splitting a high speed data streams into low speed data streams that are simultaneously transmitted over many sub-carriers. In this manuscript, we used such kind of data corresponding to test image used to check performance of OFDM technique by introducing basic noise in our simulation process named as AWGN(Additive White Gaussian Noise) in the channel. The transmitter transmits the equal number of data packets by 2*2 antennas by splitting an image's bits streams and receives each packet's information in repetition .

When compared to other modulation techniques OFDM plays a vital role in optical communication. Bit Error Rate (BER) of signals received is very sensitive to shifts of Doppler frequency and synchronization errors of carrier signals due to ICI(Inter Carrier Interference)/ISI(Inter Symbol Interference) after modulating message signals. It is Multi-carrier frequency modulation where each sub-carriers are separated by DFT (Discrete Fourier Transform) as signals of carrier are orthogonal to each other. Here symbol rates should be less than delay spread of the channel. Applications of OFDM Modulation Technique :

- Long Term Evolution mobile communications
- Digital Video Broadcasting

B. MIMO(Multiple Input Multiple Output)-OFDM

The MIMO-OFDM of provides increase of spectral efficiency and model's capacity.

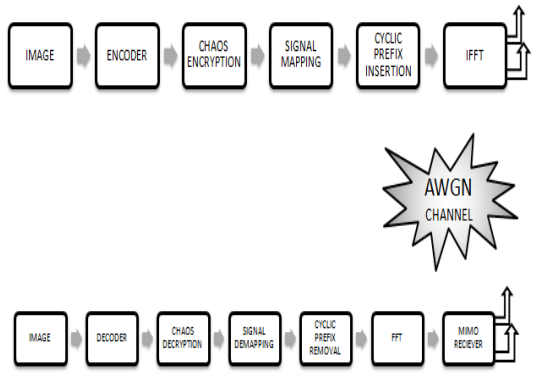

Fig. 4: Block Diagram Of This Concept

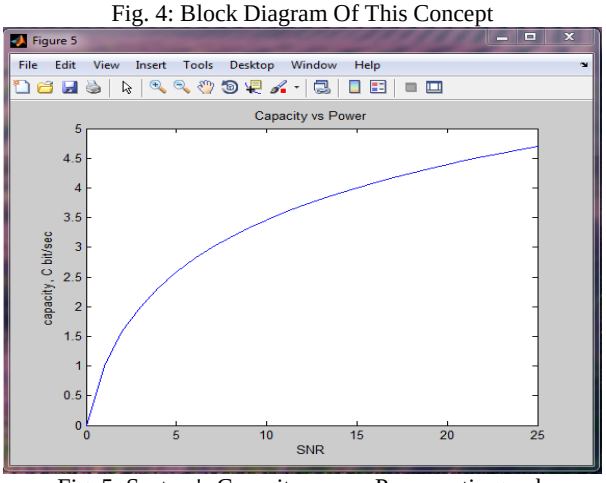

Fig. 5: System's Capacity versus Power ratio graph

C. QAM(Quadrature Amplitude Modulation)

This is one of the types of OFDM modulation which we implanted in this concept as it has many advantages than other modulation techniques. Further we can develop this process with different bit rates like 64-QAM for, 128-QAM and 256-QAM techniques. Here we used 16-QAM to transmit only 4bits per symbol.

$$Symbols/s = \frac{bits/s}{bits/symbol}$$

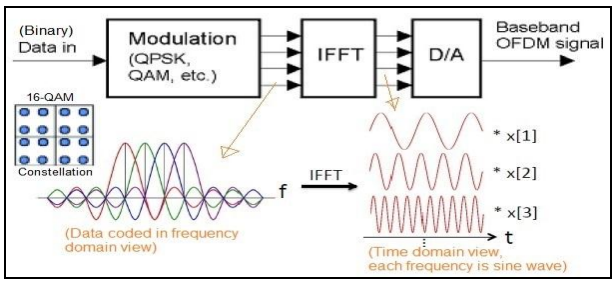

Fig 6: 16-QAM Modulation Process

III. CHAOS ENCRYPTION BASED ALGORITHM

In current digital communication technologies, secrecy of image transmission is not easy. So Chaos encryption technique is used which protect digital information from eavesdropper by masking the original pixels information. Chaos encrypted sequence is unpredictable as threshold function is introduced for encryption key generator. The following steps are followed in this paper.

STEP 1: Plain grey scale image with 256*256 size is taken.

STEP 2: Every pixel, that is every row by column values are summed up if predicted values of pixels given for known input image. Otherwise go through for every pixels for masking the values of pixels.

STEP 3: Chaotic logistic mapping is done for creating complex and chaotic behavior arised from very simple Non-linear equations.

$$x(n) = u*x*(1-x)$$

where $x \epsilon [0, 1]$ and $u \epsilon [0,9]$ where these intervals having long float values are chosen for further calculations. Proceeded in the interval [8.57,9], that map reveals one kind of behavior in random.

STEP 4: Then threshold function of found value is equated to a threshold pixel values 'n'.

$$n = thrldfun(x(n))$$

STEP 5: Do BITXOR function for original image pixel values and newly found threshold pixel values which results an encrypted ciphered image.

Etxt(i,j)=**bitxor**(F11(i,j),n)

where Etxt means Encrypted text values for source image is obtained by XORing original image pixels with a threshold pixel values.

STEP 6: This is how key values for every data is generated.

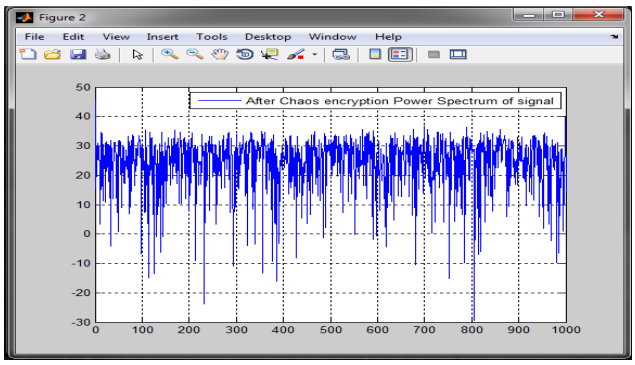

FIG 7: AFTER CHAOS ENCRYPTION

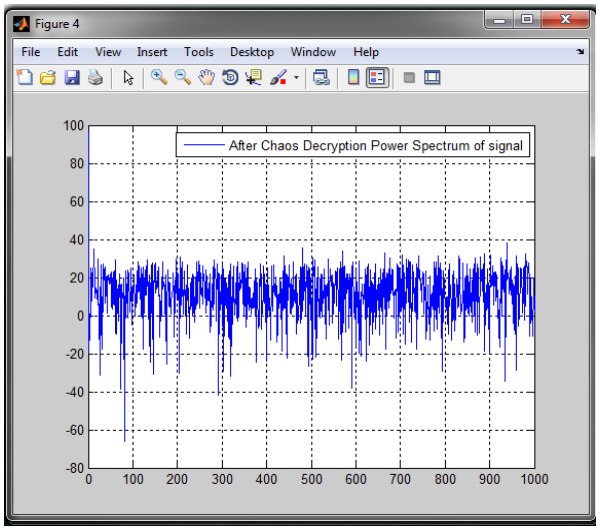

FIG 8: AFTER CHAOS DECRYPTION

V. FLOW CHART

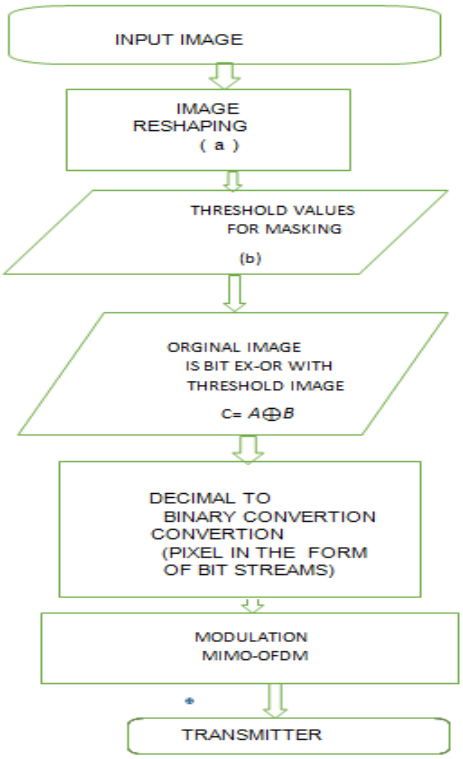

FIG 9: TRANSMISSION PROCESS

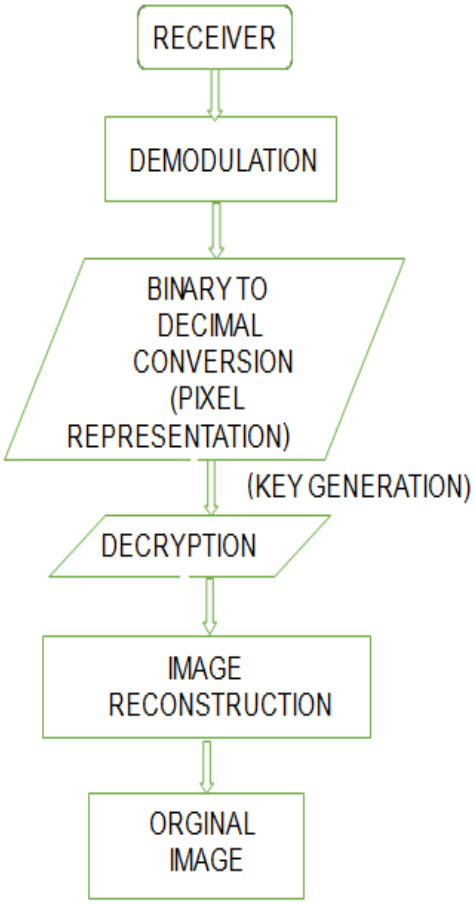

FIG 10: RECEPTION PROCESS

IV. RESULTS AND CONCLUSION

This paper illustrates the process of the MIMO-OFDM with secured image transmission met above mentioned objectives in MATLAB simulation.

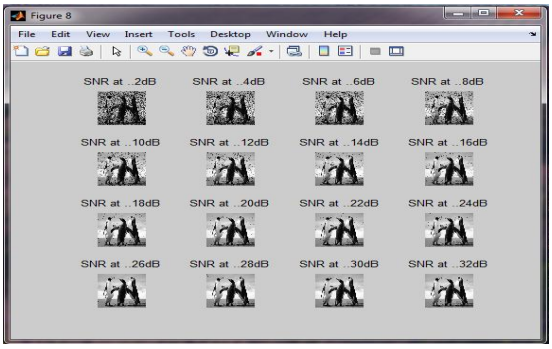

Fig 11: Varied SNR at dB

Here AWGN Channel is assumed. It shows the improved power efficiency by implementing this concept.

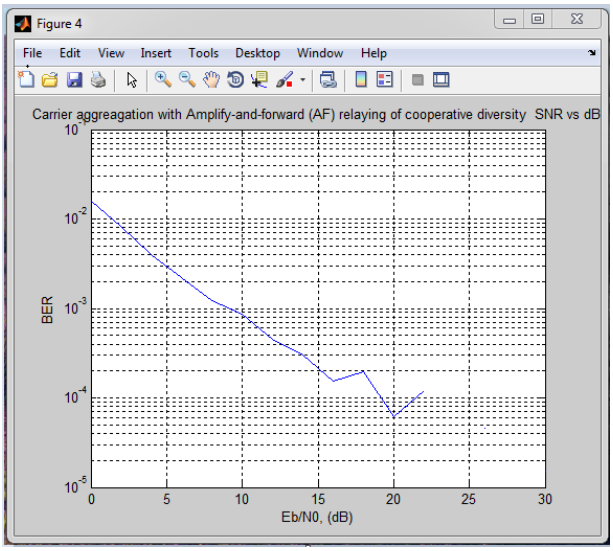

Fig 11: E_b/N_0 versus BER (Bit Error Rate)

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