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IMPROVING THE PERFORMANCE OF SMARTPHONE APPLICATION TRAFFIC USING 4G/LTE TECHNOLOGY

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Abstract— Mobile phone technology is going through revolutionary changes in last few years. As number of Smartphone is exceeding the number of desktops and personal computers, researchers are thinking of new ways to improve the capabilities of Smartphone's. Key problems that researchers are trying to solve include isolation, vendor lock-ins, mobile cloud computing, and security, but the main issues are speed, QoS, security load balancing efficiency and hierarchy aware cloudlet. Signals generated by each mobile phone in the communication network are transmitted in the form of signals with help of transmitter and receive that signal with the receiver (OFDM). One of the most promising multi-carrier system, Orthogonal Frequency Division Multiplexing (OFDM) forms basis for all 4G wireless communication systems due to its large capacity to allow the number of subcarriers, high data rate and ubiquitous coverage with high mobility. When the signal is transmitted some noise is added with the original signal. If the value of noise is grater the value of PSNR will increase. To improve the efficiency of the smart phone traffic in this paper we used the chaotic communication to reduce the PSNR value in the signal while transmitting from the OFDM system.

Index Terms— **Mobile computing, OFDM transmitter, Bit Conversion, Chaotic Communication.**

I.INTRODUCTION

We have become accustomed to an almost complete presence of digital networks in our daily lives. Everywhere you go, you can plug your laptop into an Ethernet slot, connect your iPad to an available wifi hot spot, or just use your cell phone via 3G mobile data network. However, this is not universally true throughout the world. Many places are sparsely populated, or the people living there do not have the resources to deploy such networks [1].

The telecommunications' industry is in the midst of a veritable explosion in wireless technologies. Once exclusively military, satellite and cellular technologies are now commercially driven by ever more demanding consumers, who are ready for seamless communication from their home to their car, to their office, or even for outdoor activities. With this increased demand comes a growing need to transmit information wirelessly, quickly and accurately. To address this need, communications engineer have combined technologies suitable for high rate transmission with forward error correction (FEC) techniques. This is particularly important as wireless communications channels are far more hostile as opposed to wire alternatives, and the need for mobility proves especially challenging for reliable communications [1].

The exponential growth in the development and acceptance of mobile communications in recent years is especially observed in the fields of wireless local area networks, mobile systems, and ubiquitous computing. This growth is mainly due to the mobility offered to users, providing access to information anywhere, user friendliness, and easy deployment. Furthermore, the scalability and flexibility of mobile communications increase users' productivity and efficiency [1] [2].

Today, mathematical theory of the chaos is a fundamental base of natural science. It proves that the complexity of the behavior of the chaotic systems stems from the exponentially unstable dynamics, rather than from the fluctuations or big degree of freedom. Classical example of the chaotic behavior are Brownian motion, change of the weather, behavior of the financial markets, the biological processes in the living organisms, the fluctuation of the astronomical orbit, etc.

During the past two decades, there has been tremendous interest worldwide in the possibility of using chaos in communication systems. Many different chaos-based decryption algorithms have been proposed up to date. They can be classified into two basic categories, namely, coherent and non-coherent approaches. In the first approach, the chaotic signal has to be recovered from the received signal by synchronization, while in the second one the demodulation is done solely based on the received signal, i.e. without synchronization.

The main issue with the smart phone signal transmission over the wireless network is the efficiency of the transmitted signal over the communication network. Noise added with the signal when the signal is transmitted from the communication network. This will increase the PSNR ratio in the communication system and reduce the efficiency of the transmitted signal. So to improve the efficiency transmission of smart phones traffic in the wireless area network we use chaotic communication system in the transmitting medium.

II. OFDM TRANSMITTER AND RECEIVER

OFDM is simply defined as a form of multi-carrier modulation where the carrier spacing is carefully selected so that each sub carrier is orthogonal to the other sub carriers. Two signals are orthogonal if their dot product is zero [3] [4]. That is, if you take two signals multiply them together and if their integral over an interval is zero, then two signals are orthogonal in that interval. Orthogonality can be achieved by carefully selecting carrier spacing, such as letting the carrier spacing be equal to the reciprocal of the useful symbol period. As the sub carriers are orthogonal, the spectrum of each carrier has a null at the center frequency of each of the other carriers in the system. This results in no interference between the carriers, allowing them to be spaced as close as theoretically possible. Mathematically, suppose we have a set of signals ψ, where ψp is the p-th element in the set.

$$\int_a^b \psi_p(t)\, \psi_q^*(t)\, dt = \begin{cases} k & \text{for } p=q \\ 0 & \text{for } p \neq q \end{cases} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where, ψ p and ψ are ^{h} and ^{h} elements in the set. The signals are orthogonal if the integral value is zero. Interval [a, b] is a symbol period. Since the carriers are orthogonal to each other the nulls of one carrier coincides with the peak of another sub carrier. As a result it is possible to extract the sub carrier of interest.

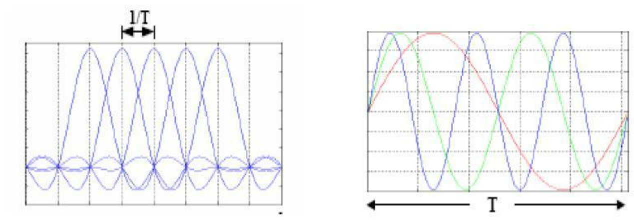


Figure 1 frequency spectrum of an OFDM transmission

OFDM transmits a large number of narrowband sub-channels. The frequency range between carriers is carefully chosen in order to make them orthogonal one another. In fact, the carriers are separated by an interval of 1/T, where T represents the duration of an OFDM symbol. The frequency spectrum of an OFDM transmission is illustrated in figure 1. Each sine of the frequency spectrum in the Fig 1 corresponds to a sinusoidal carrier modulated by a rectangular waveform representing the information symbol. One could easily notice that the frequency spectrum of one carrier exhibits zero-crossing at central frequencies corresponding to all other carriers. At these frequencies, the inter-carrier interference is eliminated, although the individual spectra of subcarriers overlap. It is well known, orthogonal signals can be separated at the receiver by correlation techniques [5]. The receiver acts as a bank of demodulators, translating each carrier down to baseband, the resulting signal then being integrated over a symbol period to recover the data. If the other carriers all beat down to frequencies which, in the time domain means an integer number of cycles per symbol period (T), then the integration process results in a zero contribution from all these carriers. The waveform of some carriers in a OFDM transmission is illustrated in Fig 1. The figure indicates the spectrum of carriers significantly over laps over the other carrier. This is contrary to the traditional FDM technique in which a guard band is provided between each carrier.

To improve the performance of the system and especially for a better resource allocation in a multi-user context, an adding spreading component in the frequency domain is a good solution which offers a better robustness to cope with the channel frequency selectivity and narrowband interferers. Thus in this system we make use of OFCDMA which is a combination of OFDM and CDMA.

III. CHAOTIC COMMUNICATION

The fundamental technology for coherent chaotic communications, similar to spread spectrum communications, grew out of harnessing FM radio non-idealities and RADAR technology[6].These systems exploit the fact that an analog communications waveform can be created/detected as well as used to directly sense environmental characteristics, leading to correlation based receivers. In 1925, British scientists E.V. Appleton and M.A.F. Barnett observed that electric radiation bounced off of the ionized gas layer in the Earth's upper atmosphere[7]. This observation led to the development of FM altimetry in the 1930s and the conceptual leap of generalized statistical signal detection via RADAR. These techniques evolved into the early stages of spread spectrum technology when the Allied forces implemented SIGSALY (also known as the Green Hornet) on 15 July 1943[8]. SIGSALY was a Bell Telephone Laboratories (BTL) invention that grew out of digitizing voice signals (a vo coder) and provided secure spread spectrum communications between the Americans and British by modulating voice signals prior to transmission with recorded galactic noise stored on phonographs.1 The voice signal was then demodulated on the other side of the Atlantic using a precisely time-synchronized replica of the original encoding sequence. Although six decades removed, SIGSALY is surprisingly similar to the instantiation of a modern analog chaotic waveform in that a seemingly random process is coupled with intelligible data.

In 1947, Claude Shannon of BTL showed[9] that the channel capacity in the presence of additive Gaussian noise is maximized by selective spreading of the transmitted signal over a bandwidth such that the sum total of signal power (a constant) and noise within the designated bandwidth are as uniformly low as possible. In other words, the signal is spread over a bandwidth such that the average power is minimized. This capacity limit is met when the signal is drawn from a set of noise-like waveforms that are received using matched filter/correlation techniques. Shannon expanded these results to communications through a noisy channel [10]as well as capacity measures for secure communications[11]. Building on BTL's mathematical foundation of channel capacity, five distinct classes of spread-spectrum technology evolved[6]:the robust yet cumbersome pure-noise solution (e.g. SIGSALY); direct sequence (DS) systems employing pseudorandom numbers that spread a carrier signal via phase-shift keying; frequency modulation with frequency wobbled over a wide bandwidth (e.g. chirped carrier frequency); frequency hopping (FH) systems that employ a pseudorandom sequence to control a frequency synthesizer; and time hopping systems that randomize temporal emissions. These systems have been developed into numerous applications (e.g. RADAR, noise wheels, cellular telephony [12], and defense communications); a quick search of the US Patent Office shows over17000 hits for the key words "spread spectrum." The chaotic communications focus of this dissertation is a digital generalization of direct sequence spread spectrum communications that functionally resembles the maximal entropy waveform characteristics of pure-noise systems.

There are many interpretations and definitions of the synchronization term [39]. Several forms of synchronization have been proposed for the chaotic systems. A typical and most widely-used scenario of the chaotic synchronization is identical synchronization, where the state of response system converges asymptotically to the state of the drive system. Recently, two forms of synchronization, called phase synchronization [40] and generalized synchronization [1][41]have been introduced.

Identical synchronization: Two continuous-time chaotical systems

$$\frac{d_x}{d_t} = F(x)$$

and

$$\frac{d'_x}{d_t} = F(x')$$

are said to synchronize identically if

$$\lim_{t\to\infty} ||x'(t) - x(t)|| = 0$$

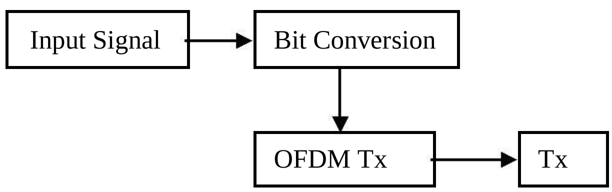
for any combination of initial states x(0) and x′(0). From a communication point of view, we may think of system as the transmitter and system as the receiver. If the same initial condition is chosen for the transmitter and the receiver, i.e. x(0) = x′(0), the both systems will evolve in a synchrony in the sense that, x′(t) will continue being equal to x(t) for all t > 0. The signal si(t) which is transmitted by a communication channel is a linear combination of basis functions gj(t). We consider the case when only one basis function g(t) is used and we assume that si(t) ≡ g(t). At the receiver side, we must recover the scalar basis function g(t) = H(x(t)) which has been derived from the state of the drive system. The basis function g(t) can be recovered by synchronizing the state of the response system identically with the drive system and applying the same function H(·). In particular, if x′(t) can be made to converge to x(t) then the estimation ˆg(t) = H(x′(t)) will converge to g(t).

Phase synchronization: This scenario of the synchronization of two coupled systems occurs if the difference |φ′(t) − φ(t)| between the "phases" of the two systems is bounded by a constant [67], where the "phase" φ(t) is some monotonically increasing function of time suitably chosen.

Generalized synchronization: This type of synchronization occurs mainly when the coupled chaotic systems are different, although it has also been used between identical chaotic systems.

IV. PROPOSED METHOD

Figure 2 shows the block diagram of the current system used for the transmission of the smart phone traffic over the wireless area network.



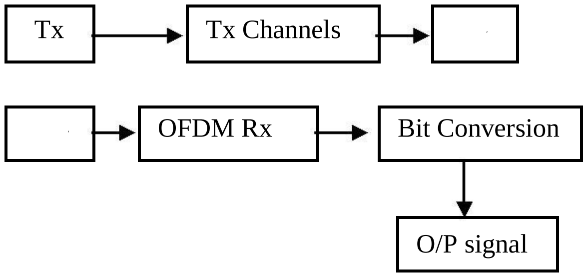


Figure 2 Block diagram of current transmission system

As shown in block diagram input signals from the smart phones are first transfer for the bit conversion block. Every signal is converted into bits and sends through OFDM transmitter. Different Transmission channels are used to transfer the bit signals from the wireless area network. On the receiving side OFDM receiver is used to receive the bit signal and bit conversion is used to obtain the original signal from the OFDM receiver. On the receiver end different parameters are calculated like BER, PSNR to find out the efficiency of the communication system.

In digital transmission, the number of bit errors is the number of received bits of a data stream over a communication channel that has been altered due to noise, interference, distortion or bit synchronization errors. The bit error rate or bit error ratio (BER) is the number of bit errors divided by the total number of transferred bits during a studied time interval. BER is a unit less performance measure, often expressed as a percentage. The bit error probability p_e is the expectation value of the BER. The BER can be considered as an approximate estimate of the bit error probability. This estimate is accurate for a long time interval and a high number of bit errors.

BER increased because of the unwanted noise added with the signal at the transmitted channel which increases the PSNR value of the system. To reduce the BER and PSNR values and improve the efficiency of the system we implement chaotic communication in the system to remove the unwanted noise from the system which helps to reduce the BER and PSNR values and improve the efficiency of the transmission channel. Figure 3 shows the block diagram of the proposed transmission system.

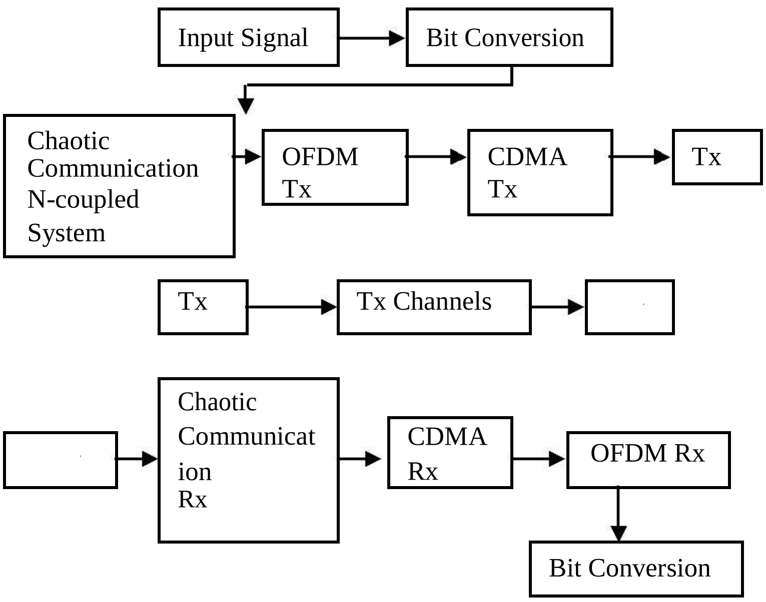


Figure 3 Block diagram of proposed transmission system

V. RESULTS

Here are some of the results representing the comparison of the BER vs SNR with 4G and without 4G.The performance of our

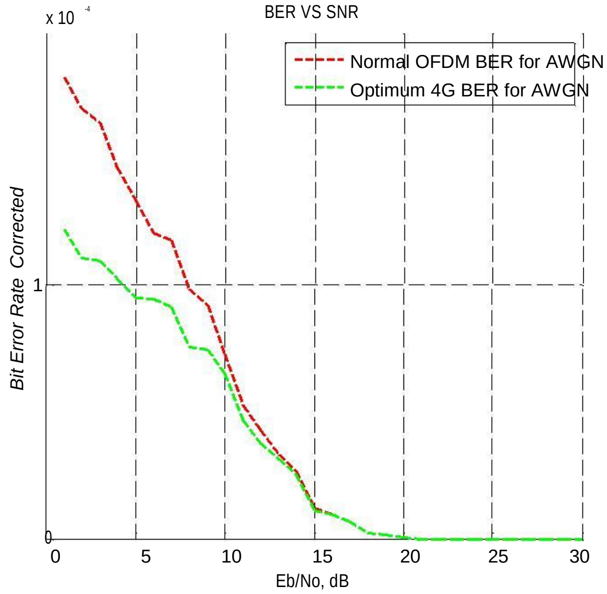


Fig 4: BER vs SNR graph for AWGN channel

The performance of the system over Rayleigh channel is as follows. The following figure shows the BER vs SNR graph over Rayleigh fading channel.

system over AWGN channel is as shown in the fig 4 below.

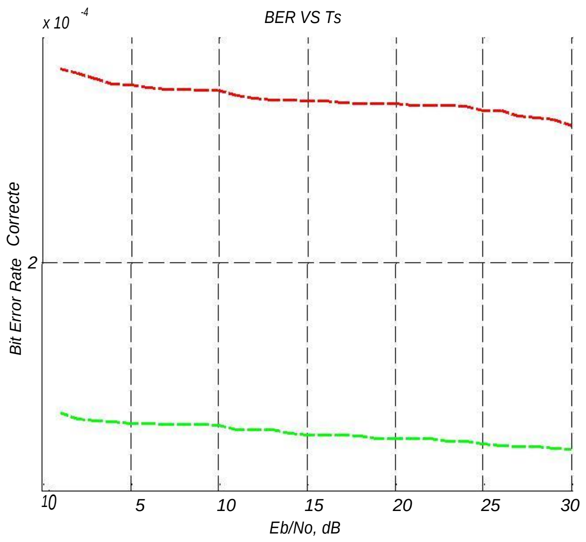


Fig5. BER vs SNR graph for Rayleigh channel

The performance evaluation for Rician Channel with constant SNR is as follows:

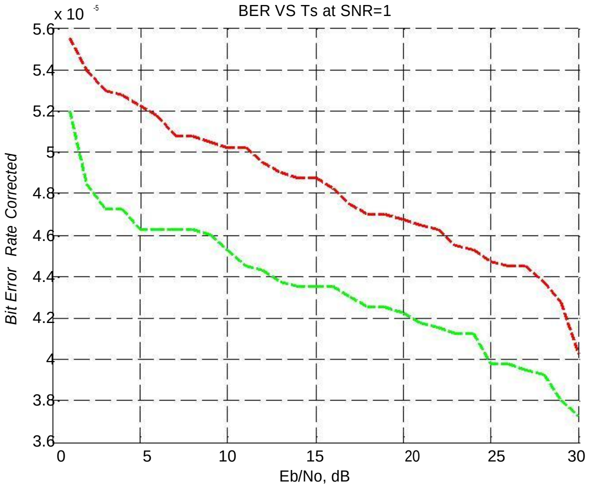


Fig6. BER vs SNR graph for Rician channel with constant SNR

The performance evaluation of Rician Channel with constant Ts is as follows:

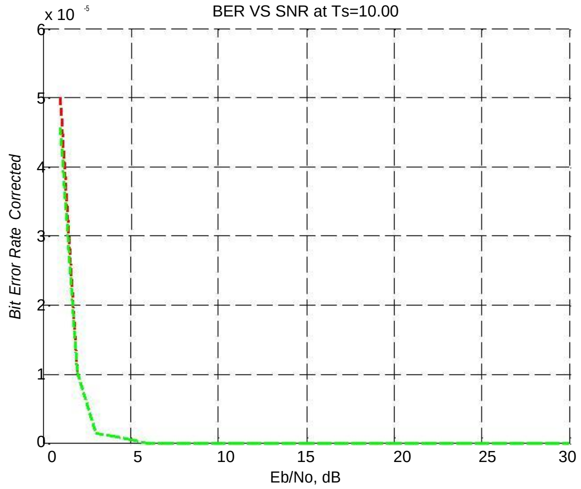


Fig7. BER vs SNR graph for Rician channel with constant Ts

VI. CONCLUSION

Our method shows a significant improvement in BER performance over the existing system. The best performance is being demonstrated with the Rayleigh fading channel which demonstrates more than 50% BER improvement over the conventional system, thereby improving the overall system efficiency. AWGN channel shows the 2nd best performance improvement of 40%, while the least improvement of about 15% is shown with Rician channel. In future we plan to implement this on the hardware and also try to improve the performance of the Rician channel

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