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Analysis of Chaotic Communication over Traditional Communication

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ABSTRACT: Communication word is having its importance since the day human exists, but day by day it is improving its form, the biggest change in communication is from analog to digital. And now for more better & secure performance we introduce chaotic communication in today's traditional communication system. The discovery of randomness in apparently predictable physical systems have evolved into a new science, the science of chaos. Chaotic systems are unstable and aperiodic, making them naturally harder to identify and to predict. In this paper the concept of chaotic communication is explained together with its applications and advantages over traditional communication methods. The majority of the research carried out so far proves that chaotic communication system has quite a number of advantages over traditional communication system. Recently, many researchers have been looking at ways to utilize the characteristics of chaos in communication systems and have actually achieved quite remarkable results. . It has wideband characteristic, it is resistant against multipath fading and it offers a cheaper solution to traditional spread spectrum systems. In chaotic communications, the digital information to be transmitted is placed directly onto a wide-band chaotic signal.

KEYWORDS: Chaos, Chaotic system, GOLD codes, Traditional communication, Randomness

I. INTRODUCTION

Communication is the way to express the expressions and feelings of one person to another person. In other words it is a medium through which a message is transmitted to its intended audience, such as print media or electronic media. But the contents may or may not be useful. The useful content of messages is known as information. Now as the world is developing day by day, the way of communication is also improving step by step as describe below in fig.1.

As Reduced to a sentence, Gutenberg's printing press's primary effect on information reproduction was to make the production of words relatively cheap. For the first time in history, the effort required to make a copy of a textual work was many times less than the effort required to create the original copy, thus making the production model of ``Make an original copy of a book, then print thousands of copies of it quickly for a profit'' practical.

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Figure 1 Means of Communication

Ever since then, technology's primary effect is to lower the cost of various production models with various media until they are practical for an increasing number of people [1].

Figure 2 Printing Media

Analog Communication

The written way of communication is an revolutionary innovation has been done in world of communication i.e. analogues way of communication, Radio and television are entirely different beasts. With radio and television, content could be broadcast quickly, even immediately (“live”), to any number of people around the country or the world. The customer had to invest in technology capable of receiving these transmissions, but the general public found radio and television more than compelling enough to invest billions of dollars in. Fast forwarding to today, we find that content with broad appeal can be broadcast profitably, news-type content can be broadcast multiple times per day (entire channels can be dedicated to what is essentially the same hour of content, like CNN), increasing the frequency of transmission to ``hours" from ``days". ``Niche" content can also succeed on a smaller scale, though there is still a relatively high break-even point. The schedules of broadcast content started its intricate dance with the American public as each started to schedule their lives around each other.

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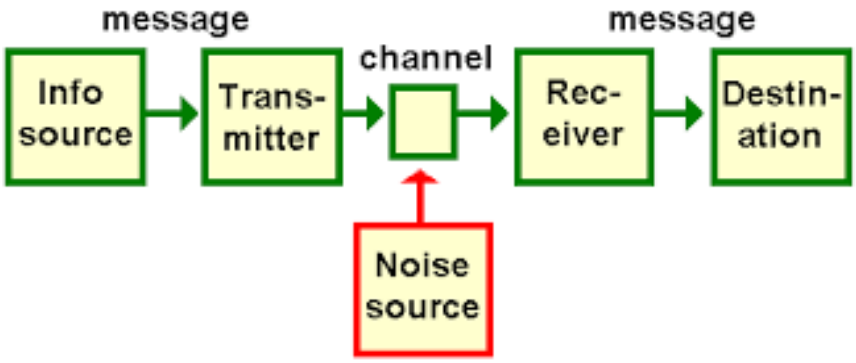

Figure 3 Block Diagram of Analog Communication

Radio and television also broke free of the tyranny of the written word. Radio was one of the first technologies that could handle sound directly (the only competition are records and when you consider that a truly viable technology is a judgment call), and television introduced the even more exciting world of video. It was a long time before this truly strained copyright law, as it was not until the 1980's that the mass-market consumer had any easy, practical means of reproduction of video (via the VCR). Concern about the equivalent of recording from a radio did not exist until the 2000's (the ability to record a digital stream directly from a digital radio), because the mass-market consumer did not have the technology to widely reproduce and distribute a recording with any quality. So we can see that one of the pressures on copyright law is the availability of technology that can produce or reproduce content in a given medium.

Radio and television have their own constraining factors too. The expense necessary to put together even the simplest of professional-quality programs is quite high, which introduces the concept of "cost of entry". In theory anybody could start up a television program or network; in practice, it is vastly more difficult than simply having a printing press print 1000 copies of something. Large transmission towers must be constructed, electromagnetic spectrum must be allocated (extremely limited in television before the advent of UHF), and a large staff must be hired to run this station. Thus, only a limited number of large networks could afford to take full advantage of the medium. This has changed with the wide-scale use of cable, and its corresponding ability to transmit low-quality programs without an expensive transmission tower, allowing "public access" channels (probably only due to Federal mandate, though it's hard to know for certain), but the networks still dominate.

The existence of a large-scale distribution network for some kind of content, like sound recordings, tends to imply some sort of standard medium for distributing that content. As more people own players for that medium, the technological pressure to create technology to allow the mass-market consumer to also create content on that medium increases. Thus, a few years after the introduction of the CD-ROM, we get mass-market CD writers. DVD writers arrived even more quickly than CD writers did, relative to the initial introduction of the medium. A large-scale retail distribution method by its very existence tends to create market pressure for the creation of technology that will be capable of allowing the user to, among other things, violate copyright laws. Another way of analog communication is Telephone .Telephones are much like the postal service. In general, telephones are hardly different at all from speaking face to face, and in general there is little special treatment required to handle them. But I do mention them because of the nuisance issues that the law has had to deal with regard to telemarketers, scammers, and other people abusing the medium for personal gain. We will find the principles inherent in the laws laid down for telephones useful in some other similar circumstances later, most notably the issues surrounding "forced" communication, such as e-mail spam.

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Digital communication

After this analog communication, communication system is then changed into digital communication which is very frequently used communication in today's world. Which gives us the most powerful way of communication i.e. internet services through computers and laptops.

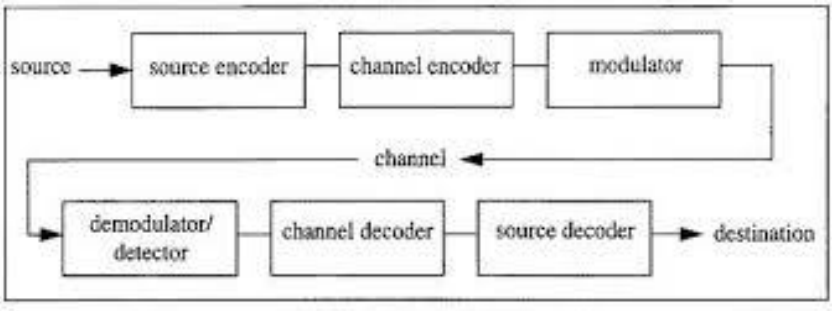

Figure 4 Block Diagram of Digital Communication

The Internet in a period of just a few years has taken each of the bubbles that we saw and rapidly expanded each of them until they all touch, overlap, and envelop each other. For instance, creating a video for an audience of two is possible because the Internet expands the capabilities of a consumer to have much of the distribution power of a major television network to send someone a video. On the other side, the Internet expands the television studio's viable scales of production, usually limited only to the ``ultra-large" scale, to include the ability to make truly economical micro content available. Similar things have occurred in the radio domain, and entire sites have indeed sprung up in an attempt to make a profit off of this, such as Live365.com, which assists people in creating what are essentially radio stations. Many social networking sites like facebook, twitter has growing very fast as a best way of communication [2].

Figure 5 World Wide Networking

To prevent abject absurdity requires extreme effort on the part of the judge, and the result is still far from logically rigorous; instead it smells like an attempt to continue to justify a law even in the face of obvious absurdities. One could hardly imagine a more thorough way to challenge the traditional communications frameworks.

FDM is used, in which each signal is assigned a different carrier frequency within the main channel. The assigned carrier frequencies are separated by the guard bands, which act as buffer zones to reduce the inter-carrier-

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interference (ICI), or cross talk, from adjacent spectral regions. However, this separation in the spectrum wastes the available bandwidth. Contrary to FDM, OFDM uses overlapped orthogonal sub-carriers to divide a broadband frequency-selective channel into a number of flat fading channels, which yields tremendous bandwidth savings. OFDM gives the incredible growth in the industry as manifest by the seemingly infinite demand for wireless products and services and the accompanying need for superior performance of these systems in congested and electronically demanding environments; it is evident that OFDM will be at the core of many future high data rate communications systems. In order to offer secure communication and to improve system performance chaotic sequence in OFDM (orthogonal frequency division multiplexing) can be used. Chaotically modulated signals are sent in each sub-carrier of a conventional OFDM system [4].

II. CHAOTIC SYSTEMS

All systems can be basically divided into three types:

- Deterministic systems

These are systems for which for a given set of conditions the result can be predicted and the output does not vary much with change in initial conditions

- Stochastic systems

These systems are not as reliable as deterministic systems. Their output can be predicted only for a certain range of values

- Chaotic systems

Chaotic systems are the most unpredictable of the three systems. Moreover they are very sensitive to initial conditions and a small change in initial conditions can bring about a great change in its output.

Chaotic Communication

The discovery of randomness in apparently predictable physical systems have evolved into a new science, the science of chaos. Chaotic systems are unstable and aperiodic, making them naturally harder to identify and to predict.Recently, many researchers have been looking at ways to utilize the characteristics of chaos in communication systems and have actually achieved quite remarkable results. This field of communication is called Chaotic Communication.

Chaotic communication signals are spread spectrum signals, which utilize large bandwidth and have low power spectrum density. In traditional communication systems, the analogue sample functions sent through the channel are weight sums of sinusoid waveforms and are linear. However, in chaotic communication systems, the samples are segments of chaotic waveforms and are nonlinear.

This nonlinear, unstable and aperiodic characteristic of chaotic communication has numerous features that make it attractive for communication use. It has wideband characteristic, it is resistant against multipath fading and it offers a cheaper solution to traditional spread spectrum systems. In chaotic communications, the digital information to be transmitted is placed directly onto a wide-band chaotic signal.

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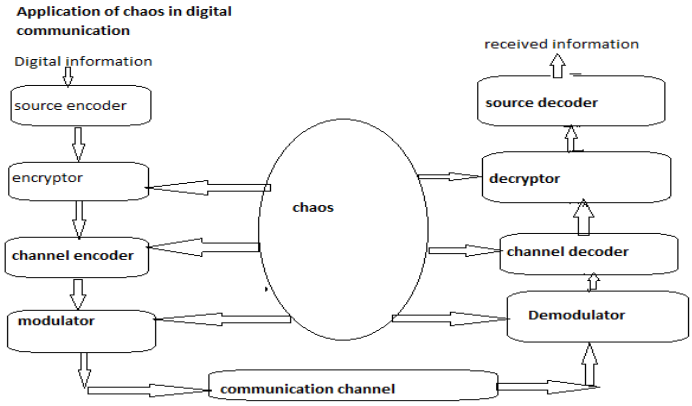

Figure 6 Chaotic communication System

In this paper the concept of chaotic communication is explained together with its applications and advantages over traditional communication methods. The majority of the research carried out so far proves that chaotic communication system has quite a number of advantages over traditional communication system**.**

Applications of chaotic communication

- Used in secure communication.
- Used in Ultra Wide Band radio.
- Used in radar and sonar.
- Used in oscillator.
- Used in modulation technique.
- Used in spread spectrum.
- Used for secure communication Conventional Sinusoidal-based Communication vs. Chaos-based Communication Conventional Chaotic.

III. ADVANTAGES OF CHAOTIC COMMUNICATION OVER TRADITIONAL METHODS

- Chaotic signals has broadband spectrum, hence the presence of information does not necessarily change the properties of the signal.
- Power output remains constant regardless of information content.
- It is resistant against multipath fading and offers cheaper solution to traditional spread spectrum systems.
- Chaotic signals are aperiodic therefore limited predictability. Chaotic signals are complex in structure and impossible to predict over longtime.
- Chaotic signals appear noise like.
- Hence chaotic signal can be used for providing security at physical level.
- At high speed it is easier to generate strong, high power chaotic signals than periodic signals.
- Chaotic signals are not sensitive to initial conditions and have noise like time series
- Chaotic transmission has less risks of interception and is hard to detect by eaves dropper.
- In chaotic communication, then on linear characteristic of communication devices are utilized instead of being avoided, this eliminates the complicated measures to maintain linearity.

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- Chaotic communication systems can function over a larger dynamical range, with fewer complex components and operate at higher power levels than traditional communication systems.
- The optimal asynchronous CDMA codes using chaotic spread-spectrum sequences can support 15% more users than the standard GOLD codes for the same bit error rate (BER) performance.
- It has auto cross correlation properties, low multipath interference and self-synchronization property.
- Power output remains constant regardless of the information content.
- It is resistant against multi-path fading and offers cheaper solution to traditional spread spectrum systems.
- Chaotic signal are aperiodic therefore limited predictability [9].

IV. RESULT ANALYSIS

A system with chaotic sequence is compared with the tradition communication system. Here we have designed a digital communication trans-receiver having OFDM technique. Firstly a traditional system is seen where the spread spectrum is not used but for enhancing the system is terms of spectral efficiency, security and high data rate a spreading technique i.e. chaotic sequence is introduced. The proposed system is implemented with MATLAB. Fig.7 shows a traditional system which is compared with proposed system shown in fig.8.
Chaotic sequence used is based on the algorithm shown below:

$$x_{n+1} = r x_n (1 - x_n)$$

where:

x_n is a number between zero and one which represents the ratio of existing population to the maximum possible population at year *n*, and hence x_0 represents the initial ratio of population to maximum population (at year 0)

r is a positive number, and represents a combined rate for reproduction and starvation.

As discussed above the first graph represents the basic system with a non linear plot. Here BER ranges from 10^{-1} to 10^{-5} and SNR has been evaluated for each. In itially a steep s lope has been observed upto 10^{-3} after that a steady BER is seen for increasing SNR which degrades the system performance. Later a sharp deacrese is noted in BER with a little change in SNR.

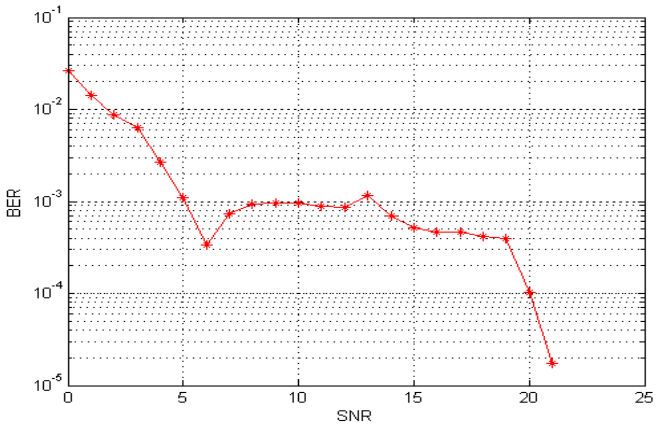

Figure 7 Traditional OFDM systems

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The computer simulations investigate the BER performance of the proposed technique called chaotic communication based on OFDM system. As seen above, in the second graph i.e. fig.8 the chaotic system with a linear plot is represented. Here BER ranges from 10^{-1} to 10^{-5} and SNR has been evaluated for each. As SNR increases BER curve leans downward this indicates reduction in bit error rate very smoothly as compared to by traditional methods.

The plot gives final improved result which is due to spreading the spectrum by using logistic sequence which is a choas. Similarly, for BER $1.0000e^{-03}$, $1.0000e^{-04}$ and $1.0000e^{-05}$ SNR values are analysed and improvement to the basic OFDM is seen.

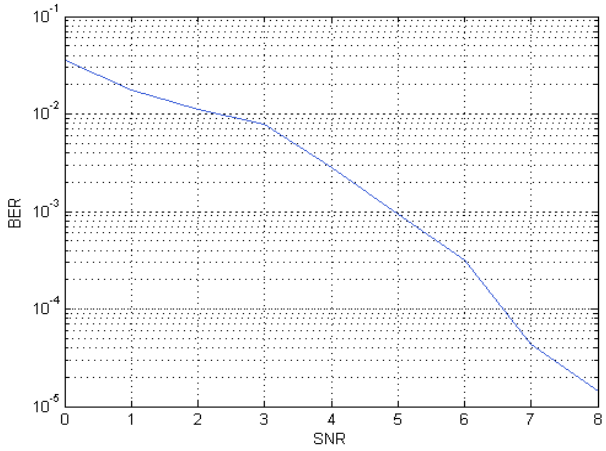

Figure 8 OFDM with chaotic sequence

V. CONCLUSION AND FUTURE WORK

A very brief overview on Chaotic Communication has been described, explaining the system setup of synchronized chaotic communication and direct chaotic communication with comparison to traditional communication system setup. A few of the main chaotic modulating schemes have been described; however, it was not possible to explain some of them in depth due to space limitations. The majority of the research carried out so far proves that chaotic communication system has quite a number of advantages over traditional communication every technology has its own advantages and disadvantages. We also had an over view of history of chaotic secure communications. We studied about attractors, chaotic systems and signal and about comparison of conventional over chaotic communication and their applications. Therefore, chaotic communication has to be used sensibly, it should lead to human integrity and benefit to the mankind. Here we have used 2D chaotic sequence further work can be extended for 3D chaotic sequence. The channel condition parameter can be more realistic and can be analyzed for more practical implementation.

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BIOGRAPHY

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