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Review on Transceiver Architectures.

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ABSTRACT

This paper is mainly focused on survey of transmitter and receiver architecture design. Code division multiple access (CDMA) uses spread spectrum technology, in which each user is allocated to a unique code and it permits multiple users to be multiplexed over the same physical channel. CDMA permits number of users to transmit and receive in the single channel, at the same time period. The transmitter and receiver ends are synchronized. The synthesis process gives an increase in overall speed of the system occurred by multiple tools, and power consumption of CDMA system will be reduced and errors are not produced in this system. In modern years, lots of operation is performed in both industries and academics into the development of CDMA. In CDMA transceiver multiple signals occupy the same frequency signal band being distinguished by introducing different spreading codes. Digital cellular telephone system and personal communication system uses CDMA communication.

Keywords: Transceiver, spread spectrum TDMA, FDMA, MC-CDMA .

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INTRODUCTION

Over the past ten years, wireless and cellular network arena communication systems have been developing rapidly. As the user desire becomes broad, conventional communication systems like TDMA and FDMA are becoming inadequate for some of the application in today's communication requirements. The above mentioned systems are replaced by a current system called CDMA. The aim of this system is to transmit the signals through a finite linear band limited channel without inter channel or inter symbol interference simultaneously [3]. This current CDMA system exploits the spread spectrum technique where the message signal can occupy both frequency and the time domains simultaneously, so the system capacity is rapidly increased. To design multi-channel transmission system, reducing cross talk between adjacent channels must concentrate. One of the most promising cellular standards is IS-95A.

Multiple access Techniques were used to permit number of users to occupy the same bandwidth at the same time in most competent way. As the spectrum is inadequate, sharing of the spectrum is need to increase the user demand of the wireless network by allowing the available bandwidth to be used by the number of users. And this must be done within the existing users, in such a way that the quality of service endures the same. In Code Division Multiple Access (CDMA) scheme, many users of transmit and receive data concurrently on the same frequency channel. CDMA method offers many advantages attractively such thing as high amount of spectral capacity so it accommodates more active members per MHz in bandwidth; It uses the rejection narrow band interference. In CDMA, the repeated cyclic frequency could be utilized in every cell, because of the usage of pseudorandom codes. The main profit of CDMA MC is that drop outs occur only when the phone are at-least twice as far from the base station. So, it mostly used in the rural areas where GSM cannot cover the overall range. CDMA MC techniques was basically used for military applications which are based on spread spectrum communications.

In spread spectrum analysis the transmission of the signal bandwidth is much wider than the bandwidth of the original signal. The user's signal is multiplied by a particular code and spreading occurs to a particular bandwidth that is much broader than of original signal [5]. All the active users share the same frequency spectrum simultaneously active inside the channel. Spreading codes or spreading sequences can be classified into two categories of codes such as orthogonal codes and pseudo-noise (PN) codes. PN codes are pseudo-random codes that are generated by the XOR gates and shift register [7]. CDMA technique is based on the spread spectrum Communication. For a MC spread spectrum signal the Transmission section is wider than of the actual limited signal.

In a MC CDMA communication system a unique binary spreading sequence is assigned to each cell for every user and at the same time all cells shares the same frequency. The signal length of each user is separated or "de-spread" from the other end at the receiver. This is done by a correlate key and the associated code sequence. In a CDMA transmitter analysis, the source of information is modulated by a spreading code, and at the receiver end it is again correlated. Very less number of correlations between the desired and interfering users is to suppress and to reduce the multiple access interference. The dependable synchronization and dependable separation of the multiway components utilize the good auto-correlation properties. Having good auto-correlation properties is also an symptoms of better randomness of a sequence, which allows us to connect other principle sequences. The survey description is as follows, Section 2 consists the literature survey and the survey concludes at section 3.

LITERATURE REVIEW

Subhasish Banerjee el al.(2016) described the code division multiple access (CDMA) scheme of a transmitter that has been designed in VHDL language for FPGA. The main idea is to design the transmitter circuit along with the PN sequence generator (gold code), BPSK modulator block and user data signal. The main scope of the CDMA modulator on designing to minimize the design timer and to compute different types of design parameters. Also desired VHDL oriented design can be comfortably loaded in FPGA to make it a ASIC.

The main block of DS-CDMA system is the PN sequence generator. A Gold code, also called as Gold sequence, is a type of binary code used. Here the PN sequence generator has been implemented using gold sequence. Two length sequences of the same length 2n – 1(where n is the size of Linear Feedback Shift Register, LFSR). This design method provides better simulation results and requires less components for

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implementation. The average delay of this design is 1.465ps. The design of CDMA modulator with 120mW of power consumption has 3.937psec delay[3].By only changing the code, without changing the hardware we can make a new GOLD code generator circuit which creates a new CDMA transmitter.

Vaibhav K Kakade (2013) focused the Multiple access is a technique, where many users and the local stations may share the similar communication channel at the selfsame time. A channel which is allocated in short term for a specific purpose, that can be thought of a particular portion of the limited radio resource, such as someone's phone call. A multiple access method is a definition of how the channels are allocated to the many users of the system. The radio spectrum is divided into multiple channels and In DS-CDMA transmitter, the input data bits are spread by PN sequence generator. The spreading is made by multiplying the data bits with that of the PN sequence code generated. The frequency of PN sequence is higher than the Data signal. After spreading, the Data signal is modulated and then transmitted [5]. There are several schemes available for modulation, viz. BPSK, QPSK, M-QAM etc. The most widely used modulation scheme is the BPSK. In this design, BPSK modulation is focused to modulate and transmit the spread signal.

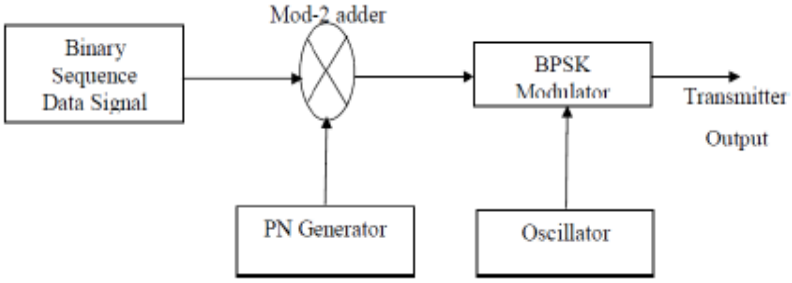

Fig 1. DS CDMA Transmitter

The normal building blocks of DS CDMA transmitter components are shown in Figure 1. The foremost block of DS-CDMA communication system is the PN sequence generator. A Pseudo-random Noise (PN) sequence code is a binary sequence that exhibits randomness properties but it has a finite length and therefore deterministic. The PN sequence generator can be implemented using LFSR's to generate different types of PN sequences. Long length sequence are LFSR based PN sequence generators (Figure 2) which can produce the maximum possible length sequence. For n bit size shift registers the PN sequence length will be 2n-1 bits.

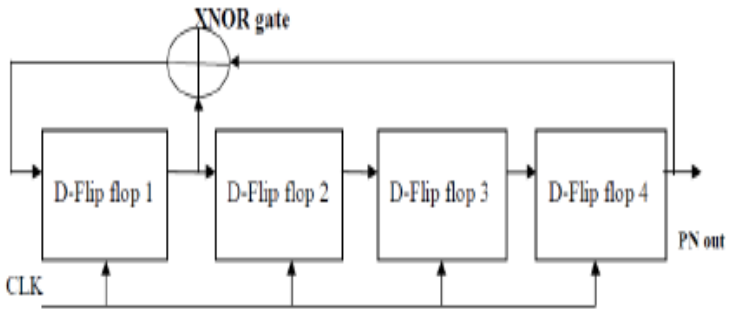

Fig 2. Block diagram of PN sequence generator

The generated PN sequences and inputs are given to XOR gate and the resulted output is spreader version of input message. In this design the transmitter and receiver has been tested using a data stream, where these data have been transmitted through implemented transmitter and then received by our implemented receiver. A comparison has been done between the transmitted and received data and better results have been achieved. Increasing the number of bits using the same topology, it is possible to reach the standard rates specified for CDMA. The design is fully reconfigurable[7], The number of bits and PN sequence can be modified, and useful for both FPGA and ASIC implementations.

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Darshini . R et al.(2016) described MC Code Division Multiple Access (MC-CDMA), based on a combination of CDMA and orthogonal frequency division multiplexing (OFDM), The highlight of this design is the PCS Generator(Figure 3), which generates a pseudo-chaotic PN sequence with good cross-correlation and auto-correlation functions that is well suited for DS-SS system. Because of long periodicity, it provides very high security and it can handle many users at the same time. It consists of a cascaded four basic cells with two 8-bit programmable registers for each. The output of the last cell is XORed together to obtain pseudo-chaotic sequence and also it fed back to the system to maintain nonlinearity that's called as (NLFSR). By increasing size of the registers and number of cells.

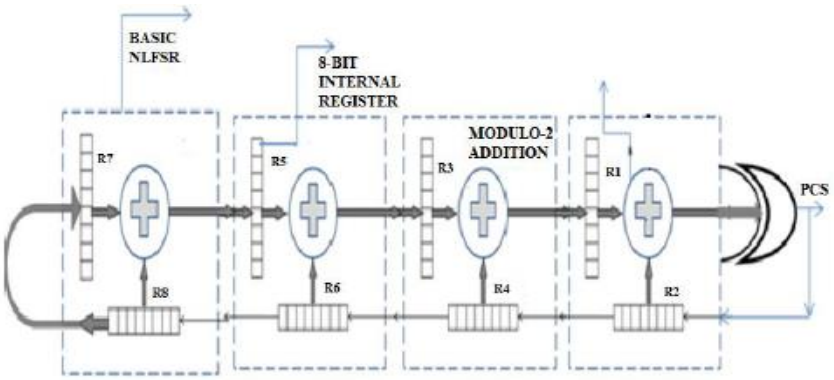

Fig 3. Pseudo Chaotic Sequence Generator

The block diagram of the MC-CDMA transmitter is shown in Figure 4. In MC-CDMA system, the original serial stream input data is first converted into parallel stream and then modulated by the chaotic phase shift keying (CPSK) modulator. sub-carriers at or near the Nyquist frequency need to be avoided by inserting zeros, In order to reduce aliasing in D/A conversion. Assuming 16 samples, to do IFFT calculation, they need to be arranged before IFFT calculation. Next the arranged data is processed by Inverse Fast Fourier Transform (IFFT) and converted back to serial data for transmission in the time domain. After the IFFT calculation, interleaving operation is performed and cyclically extended guard interval is applied between symbols to eliminate ISI caused by multi-path distortion. In more details, a periodic extension of each MC-CDMA symbol is inserted and the duration of guard interval.

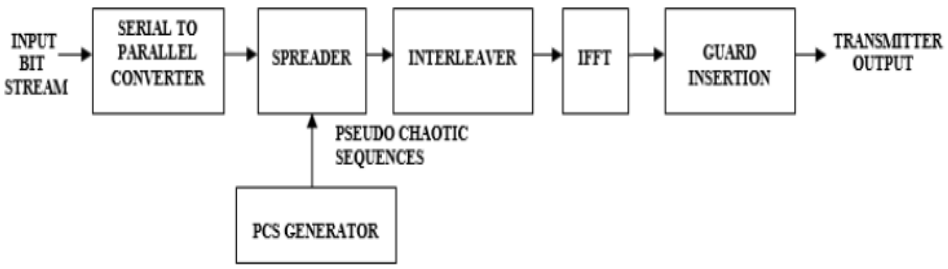

Fig 4. block diagram of the MC-CDMA transmitter

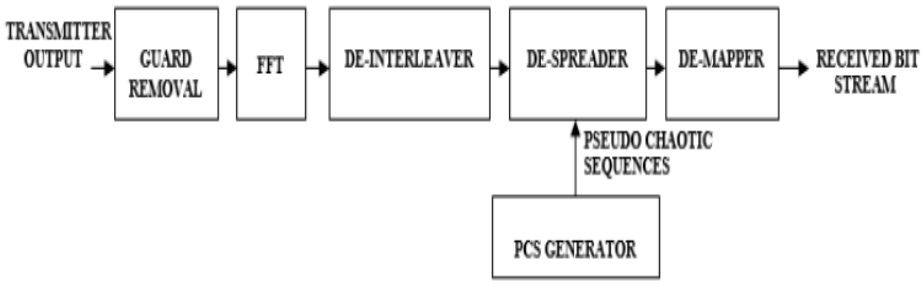

Fig 5. Block diagram of the MC-CDMA receiver

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The receiver initially removes the cyclic prefix and then performs an FFT operation for the received symbols then it brings them back to the frequency domain. Then de-interleaving operation is performed. The de-spreading steps of the blocks in frequency domain were done by decoding. The block representation of the MC-CDMA receiver is shown in Figure 5. MC-CDMA system using chaotic sequences as spreading codes significantly outperforms the conventional system. It offers very high security than traditional system. Then later on the autocorrelation properties and cross correlation properties of PCS will compared with the m-sequences[6]. The system is implemented using FPGA. First Verilog HDL codes were written for MC-CDMA transmitter and receiver and then simulated the circuit design on MODELSIM and QUARTUS II simulation software tool.

M. A. Rahman, el al.(2014) explained the performance evaluation of DS-CDMA in a Rayleigh fading environment. Performance based analysis was made for a DS-CDMA system to evaluate the signal-to-noise ratio (SNR), signal-to-interference ratio (SIR) and bit error rate (BER) with different modulation schemes like ASK, PSK and FSK. Results were analized with different data rates and they were presented in terms of SNR, SIR and BER. Computer simulation was also done by MATLAB [9]. Butterworth filtered waveform was given for better signal quality.

Decoded output signals were also evaluated to confirm the simulation results. The spread spectrum signal can be converted back to the original signal by simply multiplying the received set of sequence with the same spreading sequence. In most cases it will be a digital signal. In the case of a digital signal the data modulation is omitted and the data signal is directly multiplied by the code and the resulting signal modulates the wideband carrier.

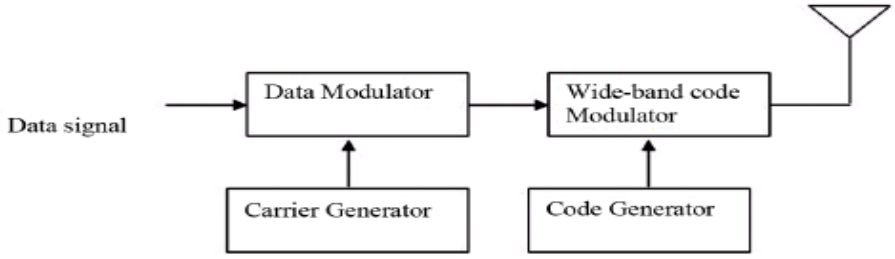

Fig 6. Bock diagram of a DS-CDMA transmitter.

From this multiplication that the direct- sequence CSMA get its name. In Figure 6 a block diagram of a DS-CDMA transmitter is shown. The binary data signal modulates an RF carrier. The modulated carrier is then modulated by the PN sequence.

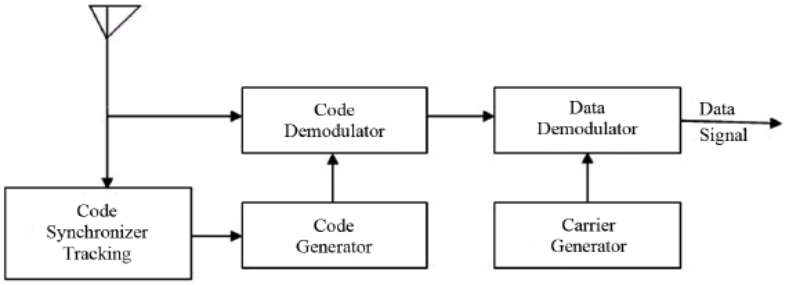

Fig 7. Block diagram of a DS-CDMA receiver structure.

To obtain the spreading sequence of the signal, the chip rate of the PN sequence must be much higher than the information signal. After transmission of the signal sequence, the receiver uses coherent demodulation technique to de-spread the spread spectrum (SS) signal, using a locally generated code sequence. The synchronization must be accomplished at the beginning of the reception step and maintained until the whole signal has been received. After de-spreading the modulated data signal and after demodulation the original signal can be recovered. Figure 7 represents the DS-CDMA receiver structure.

Vijaykumar R. Urkude el al.(2014) described the Spread spectrum techniques that used for digital communication that were originally developed for military applications because of their high security and their susceptibility to interference from other parties. The ability to predict future sequence is nevertheless possible though difficult to predict. Therefore transmission is not more secured. The amount of signal sequences that produced by Linear Feedback Shift Registers (LFSR) may be insufficient for the use of wideband DS-SS with wide range of users. LFSR techniques provide restricted pliability in providing safer side into multiple users in systems. The pseudo chaotic sequence generator is the variety of the Non Linear-Feedback Shift Registers (NLFSR).

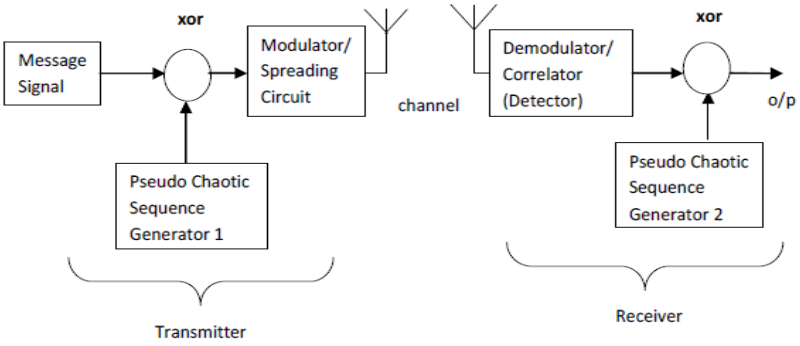

Fig 8. Chaos-based Secure Communication Architecture

The structure of the transmitter mainly consists of CPSK modulator, multiplier and PCS generator. In this analysis, the data values are spread using PCS sequence which can be produced using PCS generator. On generating PCS sequence in the system, all need is to initialize the number(n) of input registers R1 to Rn of the PCS generator. After receiving one bit input the PCS generator is enabled and it starts generating PCS sequence.

One bit of information is multiplied with 32-bits of generated PCS sequence which makes the result in 32- bits of spread sequence and the same bit is to transmit. Finally after the first data value is made spread by 32-bits of PCS sequence, the second data value may received in the multiplier end and is multiplied by the next 32-bits of the PCS sequence. The output of a multiplier is a scrambled output. The scrambled output is nothing but the encrypted message.

CONCLUSION

The survey described the reversible logic gates and the CDMA transmitter and receiver architecture. All the papers and Journals are mentioned and explained the different transmitter and receiver architecture. In the transmitter and Receiver components were designed by using Bottom-up technique. In MC CDMA, similar amount of frequency can be used in every cell, because of the use of pseudorandom codes. The leading advantage of CDMA is that dropouts occurs only during the phone are far from the base station. So, it is mainly implemented in the rural areas where GSM cannot cover the entire range of area. The complete survey they described about the different types of transceiver architecture used for transmitting and receiving data.

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