Effective Transmission And Reception Of Data Using Cdma Technology

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Abstract

CDMA stands for "Code Division Multiple Access." CDMA is a digital cellular technology. It uses spread spectrum technique. Code division multiple access (CDMA) works on the principle of code multiplexing and its advanced version, named as W-CDMA is the candidate for future land mobile networks. Its detection techniques, broadly defined as multi-user detection, differ substantially from the conventional schemes. CDMA detector are used in CDMA systems design because the complexity of these detectors is linear with the number of system's users .CDMA differs from the Time Division Multiple Access (TDMA) and Frequency Division Multiple Access (FDMA) in the sense that all users transmit across the entire frequency band (unlike FDMA) and many users can transmit simultaneously (unlike TDMA). In TDMA accessing is divided by time, in FDMA accessing is divided by frequency and in case of CDMA, it allows all the user all the time. Most of the CDMA detectors are suffering from multiple accessing interference (MAI).

Keywords: Decorrelator, Matched Filter, MMSE, Proposed Detector.

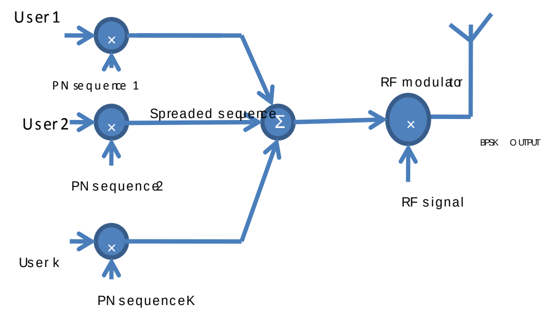
1. INTRODUCTION

CDMA stands for "Code Division Multiple Access." CDMA is a digital cellular technology. It uses spread spectrum technique. Code division multiple access (CDMA) works on the principle of code multiplexing and its advanced version, named as W-CDMA is the candidate for future land mobile networks. Its detection techniques, broadly defined as multi-user detection, differ substantially from the conventional schemes.CDMA detector are used in CDMA systems design because the complexity of these detectors is linear with the number of system's users [1].CDMA differs from the Time Division Multiple Access (TDMA) and Frequency Division Multiple Access (FDMA) in the sense that all users transmit across the entire frequency band (unlike FDMA) and many users can transmit simultaneously (unlike TDMA). CDMA doesn't design a specific frequency to each user. Each channel use fully available spectrum. Individual conversions encoded with pseudo random digital sequence. It is a military technology. It was used in Second World War in jamming transmission. Using this all stations is permitted to transmit over the entire frequency all the time. Multiple transmissions are separated using coding which makes an assumption that when multiple signals combined together they will not get gargled. They add linearly. Each bit is sub-divided into 'm' short intervals called chips. Each station is assigned to a unique m – bit code called chip sequence. To transmit a 1-bit the station will be transmitting the chip sequence and for a o-bit the station will be transmitting 1's compliment of chip sequence. No other patterns are permitted. We use bipolar signals with 1-bit being +1 and 0-bit being -1. Suppose a station is having a chip sequences. An important assumption to be noted is that all chip sequences must be pair wise orthogonal is the normalized inner product of any two different chip sequences must be zero ie, S.T=0 and S.T=0. Where T another stations chip sequence. If S is the received chip sequence and C is the chip sequence of sender, Then,If S.C=0 (C has transmitted nothing),If S.C=1(C has transmitted 1-bit) and If S.C= -1 (C has transmitted a 0 bit)

2. CDMA Features

In CDMA Each channel use fully available spectrum. Individual conversions encoded with pseudo random digital sequence. It is a military technology transmission. Using this all stations is permitted to transmit over the entire frequency all the time. Multiple transmissions are separated using coding which makes an assumption that when multiple signals combined together they will not get gargled. They add linearly. Each bit is sub-divided into 'm' short intervals called chips. Each station is assigned to a unique m – bit code called chip sequence. To transmit a 1-bit the station will be transmitting the chip sequence and for a o-bit the station will be transmitting 1's compliment of chip sequence N. In this each message with bit period Tb is multiply with a PN sequence of period N bits to produce spreaded sequence. Digital sequence does not produce any radiation at the transmitting antenna.To produce radiation at the transmitting antenna the spreaded sequence is again multiply with RF signal, results BPSK signal produce and then transmitted with help of antenna. The BPSK signal are travelling through a AWGN channel.

3. CDMA transmitter



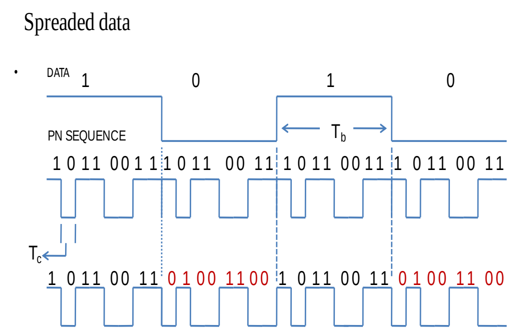


Figure shows a CDMA transmitter for K number of users, but in this dissertation design of transmitter is for 6 users. In CDMA technology for each user assign a specific and unique signature (PN sequence) code. From figure for 6 users uses a different codes for all users of different data sequence. For example user 1 data is 1 0 1 0 with a bit period of Tb. It is multiplied by a PN sequence of period 8 bits i.e. 1 0 1 1 0 0 1 1 , PN sequence period is same as data bit period Tb. Each data bit is multiply with PN sequence period of N bits, each bit in PN sequence is called CHIP with a period of Tc i.e. Tc << Tb. The multiplication operation is performed by EX-NOR gate. It produce a spreaded sequence of user 1. Similarly, for all the users generate different spreaded sequences. The multiplexer select different spreaded sequence depending upon time slot. Digital sequence does not produce radiation at the transmitting antenna. To produce and radiate at the antenna spreaded sequence is modulated with RF signal of frequency of 12MHz. The output signal of RF modulator is binary phase shift keying (BPSK) signal. In case of coherent CDMA RF modulator output is BPSK, in case of non-coherent CDMA RF modulator output is DPSK. The BPSK signals are travelling through a AWGN channel and received by the receiving antenna.

4. PN Sequence generator

1. PN sequence length=2^N-1, where N= no. of registers
2. T = period 31 bits(chips)

The PN Sequence Generator block uses a shift register to generate sequences, as shown above, The PN Sequence Generator block generates a sequence of pseudorandom binary numbers. A pseudo noise sequence can be used in a pseudorandom scrambler and descrambler. It can also be used in a direct-sequence spread-spectrum system. All r registers in the generator update their values at each time step according to the value of the incoming arrow to the shift register. The adders perform addition modulo 2. The shift register is described by the Generator Polynomial parameter, which is a primitive binary polynomial

$$g_r z^r + g_{r-1} z^{r-1} + g_{r-2} z^{r-2} + \ldots + g_0$$

. The coefficient g_k is 1 if there is a connection from the kth register, as labeled in the preceding diagram, to the adder. The leading term g_r and the constant term g_0 of the Generator Polynomial parameter must be 1. You can specify the Generator polynomial parameter using either of these formats: A vector that lists the coefficients of the polynomial in descending order of powers. The first and last entries must be 1. Note that the length of this vector is one more than the degree of the generator polynomial. A vector containing the exponents of z for the nonzero terms of the polynomial in descending order of powers. The last entry must be 0. The Initial states parameter is a vector specifying the initial values of the registers. The Initial states parameter must satisfy these criteria .All elements of the Initial states vector must be binary numbers. The length of the Initial states vector must equal the degree of the generator polynomial.

5. De-correlator detector

The decorrelator, like the matched filter, is a linear multi-user detector, but unlike the matched filter, it uses information from all of the other users to remove interference. The decorrelator inverts the channel leaving the received signal without interference but by doing so also increases the noise. The advantage of the decorrelator is that no knowledge of the received power is necessary and its performance is independent of the power of interfering users so that it solves the near-far problem. Both synchronous and asynchronous Decorrelator have been considered, but here we consider only the synchronous case as the generalization to the asynchronous case is relatively straightforward. The simplest CDMA detector is the matched filter. But the matched filter can not cancel the multiple access interference signals as shown.

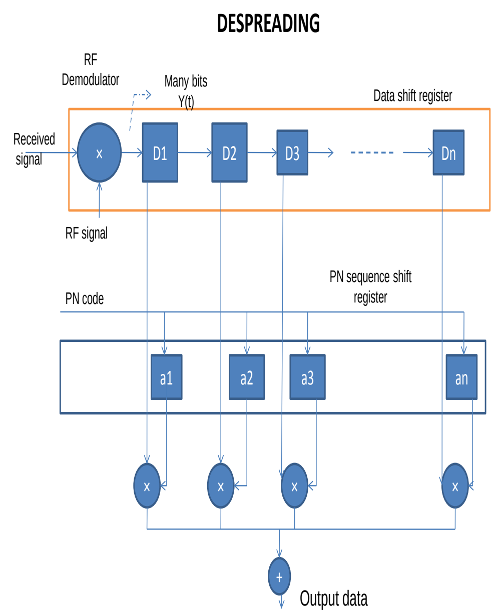
6. Matched Filter

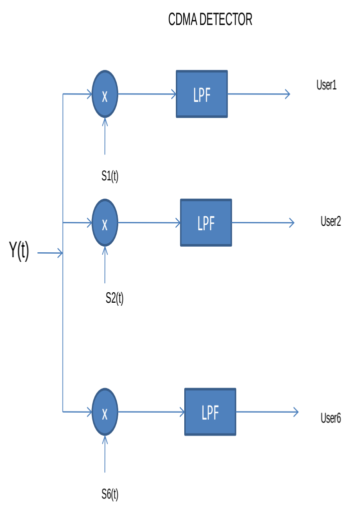
The de-correlator is a linear detector [2], which applies a linear transformation to the matched filter output to reduce the effect of multiple access interference (MAI), hence is near-far resistant. The transformation R^{-1} is applied in a decorrelator which eliminates the MAI signal. The detector that can cancel the MAl signals completely is the decorrelator detector. But the structure of this detector needs to know the entire signature codes of the system's users. This detector is very similar to the zero-forcing equalizer [6] which is used to completely eliminate ISI. The decorrelator detector has a matched filter for each user signature codes. Then it calculates the inverse of this correlation matrix. Finally it multiplies this correlation matrix inversion to the matched filters output vector. The Decorrelator detector can cancel all MAl signals because the detector of K^{th} user is only caused by the noise term n.which is independent of the signal users. The main problem in the Decorrelator detector is the neglect of noise term in the estimate b leads to an estimation error

7. Minimum Mean Square Error Detector

The MMSE, like the decorrelator detector, is a linear multi-user detector, but unlike the decorrelator detector, which applies a linear transformation to the matched filter output to reduce the effect of multiple access interference (MAI). The structure of the MMSE detector is simpler than the structure of decorrelator detector. The MMSE detector is an adaptive algorithm detector that compromises between the matched filter detector and the decorrelator detector [4].It solve the matched filter detector problems, that’s minimizes the MAl signals' powers and the noise power jointly at the output of the detector.

8. CDMA Detector





At receiver side the BPSK signal is multiply with same FR signal (because of coherent CDMA) signal and produce spreaded spectrum. The spectrum of received data in data shift register is multiplied with same PN sequence code, if both sequences are matched produced bit 1 and low-pass filter allows not matched spectrum again multiply the low pass filter does not allow.The proposed algorithm is based on the output from the MMSE detector due to its less BER. The input from the proposed detector taken from the output of the linear MMSE Detector. Since, MMSE Detector has the knowledge of the amplitude and signature waveforms of all users. The signature waveform and amplitude of all users on the receive end are known. while b_i is unknown. So, estimate of b_i defined as d and is taken from the decision of the MMSE detector.

CONCLUSION

In this work, the new proposed detector with simplerstructure may help in increasing CDMA system capacity byallowing more number of system's users to share the sameCDMA system's resources.The proposed algorithm is based on the output from theMMSE detector due to its less BER. this project.

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