Performance Analysis of Fading Channels Under Different Modulation Techniques in Secure MC-CDMA

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ABSTRACT

In this paper Multi-Code Multi-Carrier Code Division Multiple Access system is presented, that is going to be used as a wireless communication system for next generation. In this, advantages of MC-CDMA are used for rejection of interference and in clashing of multiple paths. On receiving the information about the channel, improvements in potent data rate and all over capacity of the system can be done. As in wireless communication system multipath fading is a common problem as signals are reflected by large towers, buildings, houses etc. and it ultimately results in interference of signals, so solution to this difficulty is provided by MC-CDMA. Here we have used different modulation techniques and different fading channels, and the comparison has done to reduce bit error rate.

Keywords: Bit Error Rate, BPSK MSK, QAM, QPSK

1. INTRODUCTION

Multicarrier Code Division Multiple Access (MC-CDMA) is a latest technology which supports several users at the same time to provide high data rates with good quality of service. During this technology two techniques are mixed i.e OFDM (orthogonal frequency division multiplexing) and CDMA (code division multiple access). This combination of two technologies ends up in high spectral efficiency, robustness to multipath propagation, high flexibility. MC-CDMA provides a solution to problems like sensitivity to multipath circumstances, less bandwidth efficiency, narrowband interference. MC-CDMA is the technology that has come forward to overcome the drawbacks of the individual phenomena i.e OFDM and CDMA. In MC-CDMA spreading codes are for spreading the input data symbols such as, PN sequence and Walsh codes, in frequency domain. Then parallel multi subcarriers are used for carrying data symbols over it. Its advantages include efficiency in dealing with multipath and protection against narrowband interference. Its disadvantages are sensitivity to frequency offset and phase noise.

CDMA is a technique that is for multiple accesses in which many transmitters transmit message over a single communication channel simultaneously.

2. MC CDMA System

In MC-CDMA, unlike CDMA many subcarriers are used in the place of one to introduce frequency diversity. Every user data is at start spreaded by a specified high rate spreading code in the frequency domain. A part of the symbol that is related to a chip of the spreading code is send all the way through other sub-carrier. The implementation is done according to the fig:1 shown below:

The serial input data stream is changed into parallel streams and is spreaded using CDMA spreading sequences in the frequency domain and everyone from those is multiplied, for creating the difference between users, with short spreading codes, figure 1. The parallel sequences altered back to the serial sequence and after that multiplied with the long spreading code, this is to split unlike cells in the downlink part. The spread data with the use of IDFT mapped to N orthogonal subcarriers and in ending to ignore ISI that happens due to multipath fading, guard period has been included.
By the change that is from serial to parallel, symbol duration at the subcarrier level is $P$ times elongated as in comparison from that symbol which has been used at starting. It is significant that the fading type frequency non-selective fading is maintained over all subcarriers. Or else, if the process of spreading was applied straight forward on the original data sequence, the data rate can be converted into very high and the fading type frequency selective fading will be occurred. The construction of the transmitter of an MC-CDMA method is basically same as an OFDM method. The most important variation is that the MC-CDMA method sends the similar symbol in parallel by dissimilar subcarriers, while the OFDM method sends unlike symbols. By the side of the receiving part the signal which is received is demodulated using recovering Fourier coefficients in DFT and then despreaded with both type of codes which are the long code and the short code.

3. FADING CHANNEL
Fading is a general problem in wireless communication system that is because of multipath propagation. Multipath propagation appears when a signal send using transmitter, that signal is reflected by huge obstacles and it reach at the receiver through multiple paths.

3.1 Additive White Gaussian Noise (AWGN)
The word additive has the meaning that the noise is being added to the signal that tends to unclear or covers the signal and also the receiver capacity to take the right symbol decisions is limited by it and also limited the speed at which the information is transmitted. Scientifically, thermal noise is clarified with the help of a zero mean Gaussian random process, random signal can be explained tha it is the addition of Gaussian noise random variable and an dc signal which is represented as:

$$ z = a + n $$

3.2 Rayleigh Fading
Since signal transmission happens in the environment and the transmission is close to the ground, separately from the cause of free path loss, $L_s$, the most remarkable outcome of signal degradation that is easily noticed is the multipath propagation. This effect can be the reason of fluctuations in the signal's amplitude, phase and angle of arrival which is received at receiver, increasing to terminology multipath fading.

Commonly, in mobile communications there are two kinds of fading affects which are as: large scale fading and the small scale fading. Large scale fading tells or explains the average signal power attenuation or path loss by the reason of movement above big regions. At other side, the small scale fading tells the remarkable variations in the amplitude of the signal and the phase of the signal which can be practiced as a product of tiny variations (almost like a semi wavelength) in the spatial parting which involves a receiver and also a
transmitter. Small scale fading can said be as well as the Rayleigh fading, reason behind this is that the received signal’s envelope is also shown or represented with a Rayleigh pdf.

3.3 Rician Channel

This model is used when a LOS component is presenting the channel. There are two types of components discussed here- Specular component and Random or Scatter component. The component that is the LOS component is the specular component and the second component that is the multipath component is the random component. The Rician factor \( k \) is the fraction of power of specular component with the power of the random component.

\[
k = \frac{m}{2\sigma^2}
\]

\( m \) is mean

\( \sigma^2 \) is variance

4. MODULATION TECHNIQUES

In technology at branch of electronics and telecommunications, changes making in one or more than one properties of a signal that is periodic called modulation, that periodic signal is called as the carrier signal, the information that has to be sent is with the signal that is modulating signal sent with the periodic signal. Modulation is that procedure for transmitting a message signal, for case a digital bit sequence or an analog signal, is send within the other signal that can actually transmitted. In modulation scheme of a sine waveform a narrow frequency range baseband message signal is transformed into a passband signal that can be passed by a filter.

4.1 BPSK

The most simple phase shift keying technique is BPSK. In this technique two phases are there which have a separation of 180° and it is also can be called as 2-PSK. It does not affect much that specifically at the place at that the constellation points are been situated. The BPSK this modulation scheme is best or more useful than other PSK’s because it is taking the noise that is of peak level or distortion for making the demodulator reach at the wrong decision. Still, this is only efficient in modulating at 1 bit/symbol and so it is not suitable for the users that use high data-rate.

4.2 QPSK

QPSK scheme is a case of M-ary PSK modulation scheme (M = 4) in which it is used to transmit two bits per symbol. The phase carrier gets on one of four same spacing values, like as 0, \( \pi /2 \), \( \pi \) and 3\( \pi /2 \), every value there of phase relates to a only one of its kind of duo of message bits. The execution of QPSK as compared to BPSK’s execution is more general more and also specifies the execution of the other PSK’s of higher orders. In the constellation diagram the symbols are marked in expressions of the waves that is used to send out them, those waves are sine wave and the other cosine wave.

4.3 QAM

Quadrature amplitude modulation is QAM and it is both analog and digital modulation technique. It transmits two analog signals, or two digital bit data, by making changes in the amplitudes of the two carrier waves, with the use of the digital modulation technique that is amplitude-shift keying (ASK) or the analog technique amplitude modulation (AM). The two carrier waves, generally that is sinusoids, are having a phase difference of 90° and so those are also called as quadrature carriers or quadrature components The waves after modulation are added, and the output waveform is a mixture of the two modulation techniques the phase-shift keying and the amplitude-shift keying in digital case, or of phase modulation technique and amplitude modulation technique in analog case.

Theoretically, in higher order of M-ary QAM data that is to be transmitted done in a comparatively small spectrum. On the other hand, the symbols are simply headed to errors by the reason of noise and interference, and the reason behind this is that the symbols in the constellation diagram are at very near locations. As a
result these kind of signal has to send out additional power therefore the symbol can be spread out extra and this minimizes power efficiency as in comparison with the other simpler modulation methods.

4.4 MSK:
Minimum Shift Keying (MSK) is a type of continuous-phase frequency-shift key that is used in many applications. MSK is also called as continuous phase modulation (CPM). In continuous phase modulation BW consumption is minimized consumption by eliminating phase discontinuities.

5. CONCLUSION
We have observed the performance of MC-CDMA over Rayleigh fading channel, and AWGN channel with different modulation schemes. BER is less and decreasing with MSK modulation as compared to other modulation on AWGN and Rayleigh channel. BER performance is higher for Rayleigh fading channel as comparison to other channels. This lower BER performance shows that the problem of frequency selective fading in CDMA has been reduced by MC CDMA.

6. REFERENCES