Analysis of BER of CDMA System with Channel Impairments and Generation of Non Binary Sequences

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Abstract

Analysis of the Bit Error Rate (BER) will be carried out for a Multi Carrier CDMA wireless communication link considering the effect of channels limitations like fading, delay spread etc. Different schemes of MC-CDMA will be considered and performance result will be evaluated by numerical computations. Performance degradations due to above system impairments will be evaluated and optimum system design parameters will be determined.

INTRODUCTION TO CDMA

Mobile communications are rapidly becoming more and more necessary for everyday activities. With so many more users to accommodate, more efficient use of bandwidth is a priority among cellular phone system operators. Equally important is the security and reliability of these calls. One solution that has been offered is a Code Division Multiple Access system.

Multiple access is a technique where many subscribers or local stations can share the use of the use of a communication channel at the same time or nearly so despite the fact originate from widely different locations. A channel can be defined as a portion of the limited radio resource, which is temporarily allocated for a specific purpose or user, such as someone’s phone call. A multiple access method is a definition of how the radio spectrum is divided into channels and how the channels are allocated to the many users of the system. There are three basic techniques of multiple access.
✓ Frequency Division Multiple Access (FDMA)
✓ Time Division Multiple Access (TDMA)
✓ Code Division Multiple Access (CDMA)

Basic Concept
In code division multiple access (CDMA) system, the narrowband massage signal is multiplied by a very large bandwidth signal called the spreading signal. All CDMA users use the same carrier frequency and may transmit simultaneously which we see in figure 1. Each user has its own pseudorandom codeword. The receiver performs a time correlation operation to detect only the specific desired codeword. All other codeword appear as noise. Each user operates independently with no knowledge of the other user.

LITERATURE SURVEY
Spread-Spectrum Characteristics of CDMA
Most modulation schemes try to minimize the bandwidth of this signal since bandwidth is a limited resource. However, spread spectrum techniques use a transmission bandwidth that is several orders of magnitude greater than the minimum required signal bandwidth. One of the initial reasons for doing this was military applications including guidance and communication systems. These systems were designed using spread spectrum because of its security and resistance to jamming. Asynchronous CDMA has some level of privacy built in because the signal is spread using a pseudo-random code; this code makes the spread spectrum signals appear random or have noise-like properties. A receiver cannot demodulate this transmission without knowledge of the pseudorandom sequence used to encode the data. CDMA is also resistant to jamming. A jamming signal only has a finite amount of power available to jam the signal. The jammer can either spread its energy over the entire bandwidth of the signal or jam only part of the entire signal.

Objective of the Thesis Work
- Work to be carried out for analysis of MC CDMA system with fading and interference.
- Different schemes of MC-CDMA will be considered and performance result will be evaluated.
- To evaluate the performance results in terms of Bit Error Rate.
- To determine the optimum system parameters at a given system BER.

PROBLEM STATEMENT
The major problems of MC-CDMA are:
- Multi carrier interference
- Inter carrier interference
- Near far problem and
- Multi-path fading

GENERAL PROBLEM AND SOLUTION ASSOCIATED WITH CDMA
Near Far Problem-
One of the problems encountered with CDMA is known as the "Near Far" problem. This CDMA near far problem is a key element in CDMA and as a result close control of the power within CDMA handsets is required.
The provision of a satisfactory solution of the CDMA near far problem was a key element in enabling CDMA to become a viable technology for providing a multiple access scheme for users within cellular and other radio based communications systems.

We also saw that how can the Code length effect the user capacity in the system. For a particular accepted BER we can easily serve more number of users if the code length is high.

The near-far problem is a condition in which a receiver captures a strong signal and thereby makes it impossible for the receiver to detect a weaker signal.

The near-far problem is particularly difficult in CDMA systems, where transmitters share transmission frequencies and transmission time. By contrast, FDMA and TDMA systems are less vulnerable. There is a long-standing issue that the dynamic range of one or more stages of a receiver can limit that receiver’s ability to detect a weak signal in the presence of strong signal. The near-far problem usually refers to a specific case of this in which ADC resolution limits the range of signals a receiver can detect in a direct sequence spread spectrum DSSS system such as CDMA. The receiver’s AGC must reduce its gain to prevent ADC saturation, which causes the weaker signal to fall into the noise of the ADC. This is different from a condition of one signal interfering with another because if the ADC had sufficient resolution, it would be possible to recover both signals.

**Solution for Near Far problem**

In CDMA systems and similar cellular phone-like networks, the problem is commonly solved by dynamic output power adjustment of the transmitters. That is, the closer transmitters use less power so that the SNR for all transmitters at the receiver is roughly the same. This sometimes can have a noticeable impact on battery life, which can be dramatically different depending on distance from the base station. In high-noise situations, however, closer transmitters may boost their output power, which forces distant transmitters to boost their output to maintain a good SNR. Other transmitters react to the rising noise floor by increasing their output. This process continues, and eventually distant transmitters lose their ability to maintain a usable SNR and drop from the network. This process is called power control runaway. This principle may be used to explain why an area with low signal is perfectly usable when the cell isn't heavily loaded, but when load is higher, service quality degrades significantly, sometimes to the point of insurability.

Other possible solutions to the near-far problem:
1. Increased receiver dynamic range - Use a higher resolution ADC. Increase the dynamic range of receiver stages that are saturating.

2. Dynamic output power control – Nearby transmitters decrease their output power so that all signals arrive at the receiver with similar signal strengths.

3. TDMA – Transmitters use some scheme to avoid transmitting at the same time

1) Fading Small-scale fading or fading is used to describe the rapid fluctuations of the amplitudes, phases or multipath delays of a radio signal over a short period of time or travel distance, so that large-scale path loss effects may be ignored. Fading is caused by interference between two or more versions of the transmitted signal which arrive at the receiver at slightly different times. These waves, called multipath waves, combine at the receiver antenna to give a resultant signal which can vary widely in amplitude and phase, depending on the distribution of the intensity and relative propagation time of the waves and the bandwidth of the transmitted signal.

2) Multipath in the radio channel creates small-scale fading effects. The three most important effects are:

3) Rapid changes in signal strength over a small travel distance or time interval.

4) Rapid frequency modulation due to varying Doppler shifts on different multipath signals.

5) Time dispersion (echoes) caused by multipath propagation delays.

Factors Influencing Small-Scale Fading

- Multipath propagation
- Speed of the mobile
- Speed of surrounding objects
- The transmission bandwidth of the signal

REFERENCES:


