Advanced Coding Techniques in 3G and 4G

Mr. Gomatesh S. Patil
Lecturer, Electronics and Telecommunication Department, SIT Polytechnic, Yadrav Tal-Shirol, Kolhapur, Maharashtra

Mr. U. J. Maisale
Lecturer, Electronics and Telecommunication Department SIT Polytechnic, Yadrav Tal-Shirol, Kolhapur, Maharashtra

E-mail Id: gomateshpatil@gmail.com

Abstract

In the today's world of communication we need a better strength of signal at the different relative Base station(BS) .This phenomena is achieved by different modulation as well as coding techniques. Especially in mobile technology of 3G and 4G generation. In 3G modulation and coding schemes estimated channel condition we maintain acceptable frame error rate. In MCS we maintain also propose a simplified Markov model with fewer parameters, which is suitable in systems where changes in the fading characteristics need to be accounted for in an adaptive fashion. Similar way in 4G for enhancement of system for practical implementation and data capacity. For 4G wireless networks, that demand terribly high rate up to 100 Mbits/switch the constraints limiting higher rate being severe isi due to multipath and also the restricted spectrum, such reasonably adaptive modulation based mostly multi-carrier systems applied to a wide-area atmosphere, are able to do terribly massive average user throughputs. For 3G coding techniques we use a first order finite state Markov model and for 4G OFDM-CDMA systems in Rayleigh fading channels.

Keywords: *3G and its coding technique cyclically permutable codes, 4G and its coding technique such as CDMA and OFDM (MC-CDMA)*

INTRODUCTION

In this paper we generally discuss on the different modulation and coding techniques which are used in the 3G and 4G advance mobile technologies. This technology is able to transmit and display digital images. The recent fields of mobile communication systems show a strong ability to handle all multimedia services. The major constraints limiting higher data rate are severe inter symbol interference (ISI) due to multipath channel and the limited bandwidth society demands access to huge amounts of data anywhere and at any time. In digital communication systems bandwidth and transmission power are critical resources. Thus advanced communications systems have to rely on sophisticated channel coding schemes. This all requirement which are demanded by customer is fulfilled by only design a modulation techniques which enhance transmitting and receiving system. There are different coding techniques are available for achieve this [1, 2].

Introduction of 3G

Today the demand of information field is more regarding to availability of data anywhere and at any time. To fulfill this type of needs in the digital communication systems the bandwidth and transmission power are the measure issues. Channel coding allows to reduce the transmission power by maintaining the Quality of Service (QoS) or vice versa to improve the QoS for given transmission power. 3G based systems have to carry both voice and data traffic. Thus the standard offers different data rates and coding techniques to satisfy the varying latency, throughput and error performance requirements. This paper describes a good mechanism for transmitting the group identification (ID) using cyclically permutable (CP) codes; this scheme results in significant reduction in the search space, allowing for rapid acquisition. The technique described is currently a component of the radio access technology in the 3G world.

CODING TECHNIQUES

Cyclically Permutable Codes

The method described in this paper above problem by dividing the set of scrambling codes into a larger number of groups and here we transmits a more information about the group code instead of repeatedly sending a single GIC(group identification code), we using a block code of length over an alphabet consisting of symbols as the group code. This corresponds to sending the sequence of symbols C_1C_2….Cn, where each C_i is one of the secondary synch codes SSC1 through SSCq. Because it is transmitted repeatedly, at the receiver side get an a cyclic shifting of the transmitted code word C_1C_2….Cn,by carefully observing the choice of code words, it is possible to encode the precise starting point of the scrambling code.

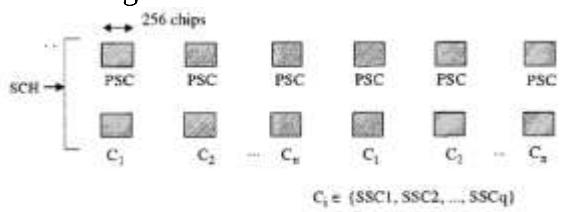


***Fig1:** Transmitting a block code on the*

Synchronization channel

A cyclically permutable (CP) code of a block having length is n and a set of code words such that no code word is a cyclic shift of another, and each code word has distinct codes shifts. Consider the example of n=16 in Fig. The symbol C_1 of the code word can be synchronized to start at the beginning of the scrambling code period. If we use only code words with distinct cyclic shifts, then the receiver knows the exact starting point of the scrambling code period from the received cyclic shift of the code word. Thus, the unique cyclic shifts of code words from a CP code encode the starting position of the scrambling code and can be used to establish frame synchronization. For this to be true, however, the length of the code word n must be a multiple of 16. If n=16, the number of symbol intervals required in Stage 3 to complete the search is S= [L/ (fN)].

Thus, for the purpose of designing a block code for transmitting scrambling code information, in general, we should pick a CP code with block length equal to the number of times the SCH is transmitted in a scrambling code period. Since this number is 16 for the frame structure discussed in this paper, a suitable block length is n=16. Choosing to be a multiple of 16 would also work, but it would adversely affect acquisition time, because the receiver must expend n time slots just to collect all the symbols from the code word. On the other hand, choosing n<16 results in an ambiguity in the start of the scrambling code period.

Cyclically Permutable Sub codes of Reed– Solomon Codes

The above idea further utilised for choosing a cyclically permutable code which is a subset of an error correcting cyclic block code. Reed–Solomon (RS) codes are well suited for our proposed PN acquisition scheme, since these codes have maximum possible distance between code words for a given block length (RS codes meet the singleton bound for cyclic codes). We will use RS codes to describe our techniques; this does not, however, preclude using other error correcting codes in a similar manner. Given a generator polynomial g(X) derived the following procedure for generating a CP sub code. If the code words are represented by C(X), then the following equation generates a CP sub code [3, 4].

Code Example

For code words we consider one example in which a Code word is in the form of RS(16,3)

A generator polynomial for a (16, 3) RS code over GF(17) is $g(X) = (X - 3^2)(X - 3^3)\ldots(X - 3^{14})$ and we can choose $s(X) = (X - 3)$.

We can encode up to $17^2 = 289$ code groups using the CP code thus generated. These code words have minimum distance. The 17-ary alphabet of the code is made of the short codes SSC1 through SSC17, transmitting a particular code word corresponds to sending a particular sequence of such short codes over the synchronization channel. If we use 64 of the available 289 code words to encode scrambling code groups (i.e. N=64), and there are 512 scrambling codes in the system, then there will be eight scrambling codes per group. The receiver determines the start of the scrambling code period by detecting the cyclic shift of the received code word. Thus, only eight codes at a known offset need to be searched in Stage 3. As another example, consider a CP sub code derived from RS(16, 2). In this case, we have $d^{min} = 15$, but we can encode only 16 code groups, and hence, there will be 32 scrambling codes per group. In this case, the search in Stage 3 is higher, although distance between code words is also larger.

Acquisition Algorithm for the CP Code-Based Scheme

The flow of the data and the designed code is defined in different stages which are explained below.

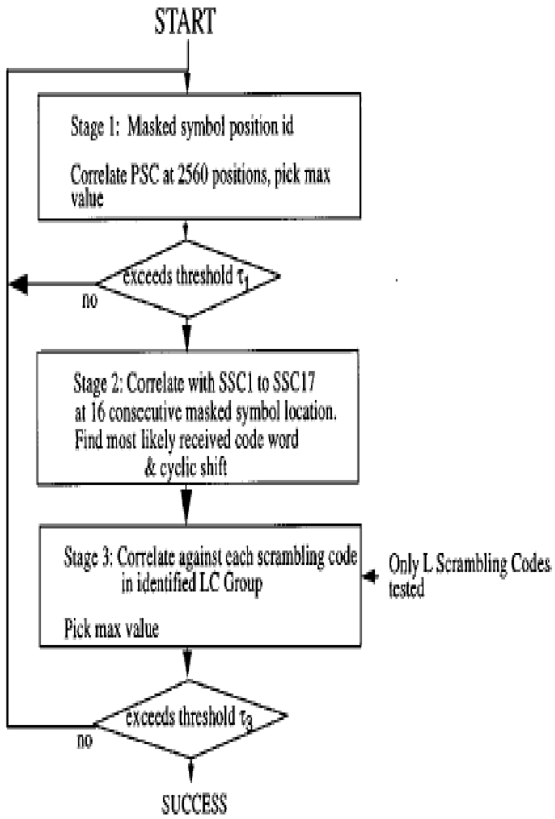


Fig 2: *Code search algorithm for CP code method*

Stage 1: Determine PSC location as in the case of the GIC method.

Stage 2*:* At the side of receiver determines which of the group code $C_1C_2\ldots C_{16}$ words is sent by the transmitter on the synchronization channel. on channel. This is done by first correlating the received signal with SSC1 through SSC17 at *16* consecutive masked symbol positions. After getting these short codes the receiver perform a decoding scheme it may be slightly soft or hard of the code word using these correlation values.

For hard decision decoding, the receiver simply determines the SSC that yields maximum correlation in each of the 16 consecutive slots. The transmitted code word may then be determined either by using an algebraic syndrome based approach or comparing the received word with each of 16 cyclic shifts of each of the 32 code words.

For soft decision (maximum likelihood) decoding, be the result of correlating the received signal in the time slot.

Stage 3: Since each group consists of only 16 scrambling codes, a total of 16 combinations need to be searched, as compared to 512 combinations when a single GIC is transmitted repeatedly. Again, this is achieved by correlating each of the candidate scrambling codes against the unmasked portion of the CPICH.

We expect the CP code-based method to achieve lower acquisition time compared to the repeated GIC method for several reasons. First, since the CP code encodes frame timing, the CP code scheme makes such a large number of code groups feasible, and this was done so as to reduce the number of scrambling codes this stage. Finally, use of code words with large minimum distance coupled with soft decision decoding provides time diversity to the CP code scheme.

Introduction of 4G coding

The most important to take care of secure inter symbol interference resulting from the high data rates and maximum utilization of bandwidth available in a spectral in the efficient way. To achieve this importance we use two different principles these are OFDM (Orthogonal Frequency Division multiplexing) and another is CDMA (Code division multiple access). In this two CDMA is used in recent years and OFDM is represents frequency hopping and direct sequence CDMA. The main role of the this technique it cancels multipath distortion in a frequency spectrum efficiently. For wide area environment today communication use combination of these two technologies i.e. OFDM and CDMA together it is called as MC-CDMA.

Coded OFDM-CDMA with adaptive modulation is one more recent technology ion the 4G mobile systems in which strength of received signal is corrupted by multipath effects. This is mixed with Adaptive modulation time variant Shannon channel capacity of narrowband fading channels. Fixed rate burst-by-burst adaptive systems, which sacrifice a guaranteed bit error rate (BER) performance for the sake of maintaining a fixed data throughput, are more amenable to employment in the context of low-delay interactive speech and video communications systems.

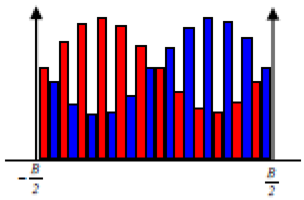
CDMA

In the CDMA technology each user is given a specific code sequence that it uses to encode its information-bearing signal. The receiver, knowing the code sequences of the user, decodes a received signal after reception and recovers the original data. This is possible since the cross correlations between the code of the desired user and the codes of the other users are small. Since the bandwidth of the code signal is chosen to be much larger than the bandwidth of the information-bearing signal, the encoding process enlarges (spreads) the spectrum of the signal and is therefore also known as spread spectrum.

OFDM

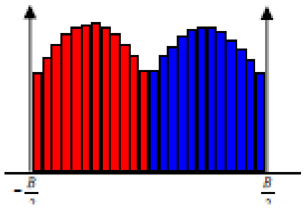
FDM Subcarrier Allocation In Wimax are grouped together to create a Sub channel.

Distributed Subcarrier



Each sub-channel consists of subcarriers that are distributed throughout the channel bandwidth, provides better frequency diversity which is beneficial at higher speeds.

Adjacent Subcarrier-



Each sub-channel consists of subcarriers adjacent to each other. Provides better multi user diversity and is useful for closed loop multi-antenna techniques.

OFDMA is a technique in which it is formed by dividing the available subcarriers in OFDM into non-overlapping subsets and assigning each user a unique subset. The properties of FDMA are given below each subcarrier is used by the one user. Each coded bit is modulated onto a subcarrier by IFFT. All of the modulated sub-carries are transmitted in parallel. OFDMA also possesses some features such as- Bandwidth options 1.25,5,10 or 20 MHZ .Entire bandwidth is divided into 128, 512, 1024 or 2048 sub carriers 20 MHZ bandwidth with 2048 subcarriers has 9.8 MHZ spacing between subcarriers. The main advantages of OFDMA is broadband signal experience frequency selective fading, BER performance is better only in fading environment, it allows different users to transmit over difficult portions of the broadcast spectrum(traffic channel).But there are also some problems in OFDMA which are the large amplitude variation increases in-band noise and increases the BER.

OFDM CDMA/ MC-CDMA

When a multicarrier transmission system is presents then channel bandwidth is divided into the multiple subchannels such that its data symbols modulated by different subcarriers can be transmitted in parallel. In order to make the most of the available bandwidth, spectra of the adjacent subchannels are allowed to overlap without inter-channel interference (ICI) in such a manner that all information-bearing waveforms of the sub-channels are orthogonal on some time interval. For high bit rate transmission The MC-CDMA transmitter and receiver in which MC-CDMA transmitter spreads the original data stream over different orthogonal subcarriers using a given spreading code in the frequency domain. The input information sequence is first converted into *P* parallel data sequence and each serial/parallel converter output is multiplied with the spreading code with length.

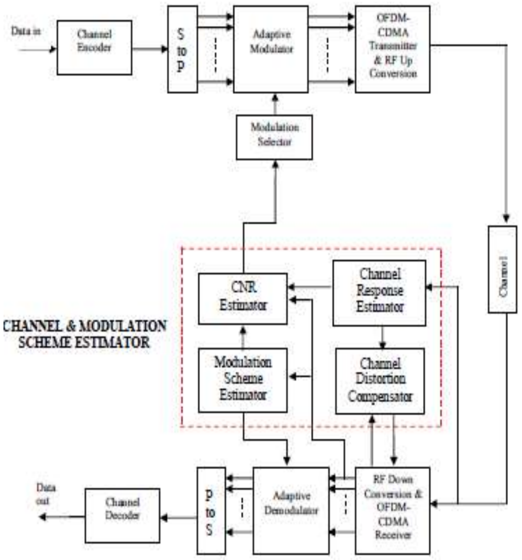


Fig3: *Block diagram of the Model*

This is the main functional block diagram of the above model. The received OFDM signal is given to the different blocks of the above block mainly channel respond estimator, Channel Distortion Compensation, Modulation Scheme Estimation. We see function of each and every block in detail way.

D.1 Channel Response Estimation-

Most of the existing blind channel response estimation algorithms make use of the subspace decomposition method in some form or the other. In [15], a subspace based channel estimation algorithm is proposed and derived, and the mean squared error (MSE) is analyzed through computer simulations for varying number of received symbols. However, no signal mapping was considered and its effect on the BER performance of the system was not investigated. Hence, in this research, this channel estimation algorithm has been reformulated and implemented in the case of adaptively modulated signals and its performance in terms of MSE and BER is analyzed.

D.2. Channel Distortion Compensation

Once the channel response is estimated and its frequency domain counterpart is calculated using the DFT matrix, the later can be used to compensate for the distortions introduced in the signal due to the fading channel. If *S(k)* and *Y(k)* are respectively the transmitted and received OFDM-CDMA symbols in discrete frequency domain, *H(k)* be the channel transfer function and N(k) the AWGN noise sample.

CONCLUSION

In this paper we define different modulation and coding techniques for 3G and 4G with their importance in the receiver to enhance the systems both in terms of practical implementation and data throughput capacity. The main Code words from a CP sub code of an error correcting cyclic code to transmit group information over the synchronization channel. MC-CDMA system can be highly effective in supporting high data rate services with mobility in the 4G wireless networks, taking substantial care of the inter-symbol interference (ISI) due to multipath and providing adequate bandwidth for the intended services.

REFERENCES

1. Blind Estimation of Channel and Modulation Scheme in Adaptive Modulation Schemes for OFDM-CDMA Based 4G Systems S. Chatterjee, W.A.C. Fernando, Member IEEE.
2. K. Higuchi, M. Sawahashi, and F. Adachi, “Fast cell search algorithm in inter-cell asynchronous DS-CDMA mobile radio,” *IEICE Trans, Commun.*, July 1998.
3. Technical specification group radio access network; Evolved universal terrestrial radio access (E-UTRA); Multiplexing and channel coding ,” 3GPP, Tech. Rep., May 2008, TS- 36.212v8.3.0.
4. Watson James A., “4G Wireless Systems: Part II”, Xcell Journal [Online]. Available: http://www.xilinx.com/publications/products/v2/wireless.htm