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Generation of Interleaver for IDMA

Deepti sahu[1], Avinash Shukla[2], Dayanand yadav[3]
[1,2,3]*Department of Electronics and Communication, PSIT College Of Engineering, Kanpur, India*
[1]deeptisahu.3092@gmail.com

***Abstract*—The demand for wireless broadband communication services has been growing steadily for last several years. Over the last two decades, wireless communications have gained enormous popularity in all over the world. It offers an attractive option requirement due to various parameters including cost, effectiveness, and mobility. The next generation mobile communication systems i.e. fourth generation (4G) are needed to support multiple services in different types of environments. 4G is being developed to accommodate the QoS (quality of service) and required data rate such as wireless broadband access, Multimedia Messaging Service (MMS), video chat, mobile TV. This paper focuses the light on various multiple access techniques proposed in 4G communication systems. Among all the multiple access (MA) techniques, it is attempted to demonstrate that IDMA (Interleave Division Multiple Access) technology can efficiently mitigate the interference among users and support high data rates without compromising the required quality of service**

***Keywords*—CDMA, IDMA, Multiple access Interleavers, Multi user detection.**

1. INTRODUCTION

In the past few years, the request for bandwidth has started to surpass the availability in wireless networks. Different techniques have been studied to improve the bandwidth, efficiency and increase the number of users that can be accommodated within each cell . The International Telecommunication Union (ITU) also defined recommendations for mobile communication system for fourth generation (4G).In these recommendations, data rates up to 100 Mbps for high mobility and up to 1 Gbps for low mobility or local wireless are predicted. Systems fulfilling these requirements are usually considered as fourth generation (4G) systems. But 3G systems provide data rate of around 3.6 7.2 Mbps. Existing multiple access techniques used in 1G/2G/3G systems (such as FDMA/TDMA/CDMA respectively) are basically suitable for voice communication only and unsuitable for high data rate transmission and burst data traffic which would be the dominant portion of traffic load in 4G system**.**

In modern communication system Code-Division-Multiple – Access (CDMA) has made its impact in wireless communication. It offers well known features such as dynamic channel sharing ,soft capacity, reuse factor of one, low dropout rate and large coverage (due to soft handover),ease of cellular planning, robustness to channel impairments and immunity against interference etc.

These advantages are available due to spreading the information over a large bandwidth. The performance of conventional CDMA system is limited by multiple access interference (MAI) as well as Inter symbol Interference (ISI) . Also, the complexity of CDMA multiuser detection has always been a serious concern for large no. of users. broadband internet access, gaming services and streamed multimedia may be provide to users. There are various numbers of multiple access techniques which are proposed for 4G system .

II. DIFFERENT TYPES OF INTERLEAVERS

Interleaving is a process of rearranging the ordering of a data sequence in a one to one deterministic format. Interleaving is a practical technique to enhance the error correcting capability of coding. In turbo coding, interleaving is used before the information data is encoded by the second component encoder. The basic role of an interleaver is to construct a long block code from small memory convolution codes, as long codes can approach the Shannon capacity limit. Secondly, it spreads out burst errors. The interleaver provides scrambled information data to the second component encoder and decorrelates inputs to the two component decoders so that an iterative suboptimum-decoding algorithm based on uncorrelated information exchange between the two component decoders can be applied. The final role of the interleaver is to break low weight input sequences, and hence increase the code free Hamming distance or reduce the number of code words with small distances in the code distance spectrum. The size and structure of interleavers play a major role in the performance of turbo codes. There are a number of interleavers, which can be implemented.

A. *Random Interleavers*

Random interleavers scramble the data of different users with different pattern. Patterns of scrambling the data of users are generated arbitrarily. Because of the scrambling of data, burst error of the channel is randomized at the receiver side The user specific Random Interleaver rearranges the elements of its input vector using a random permutation [Ping 2006]. The incoming data is rearranged using a series of generated permuter indices. A permuter isessentially a device that generates pseudo-random permutation of given memory addresses. The data is arranged according to the pseudo-random order of memory addresses. If random interleavers are employed for the purpose of user separation, then lot of memory space will be required at the transmitter and receiver ends for purpose of their storage. Also, considerable amount of bandwidth will be consumed for transmission of all these interleaver as well as computational complexity will be increase at receiver ends.

B.*Master Random Interleaver*

In random interleavers, the base station (BS) has to use a

considerable amount of memory to store the random patterns of interleavers—which may cause serious concern of storage when the number of users is large

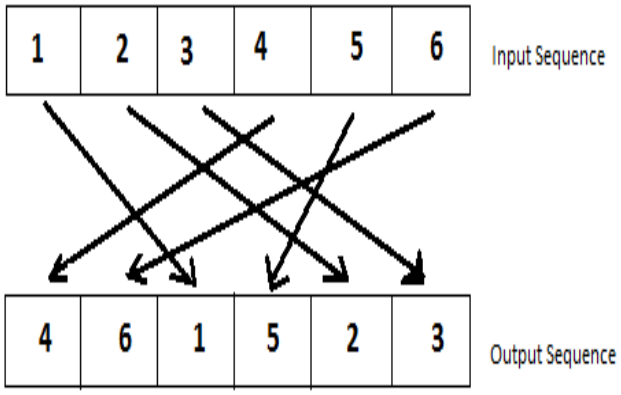

Fig 1. Random interleaver

C. *Tree Based Interleaver (TBI).*

The Memory requirement of Tree Based Interleaver is extremely low as compared to that of the Random Interleaver, while is slightly high if compared with master random interleaver . The IDMA scheme, inbuilt with random interleaver, imposes the problem of extra bandwidth consumption in the channel, along with high memory requirement at the transmitter and receiver ends.The result demonstrates that the memory required for storing the user-specific interleavers is user dependent for random interleavers in case of its deployment in IDMA scheme, while it is found to be at minimum level,

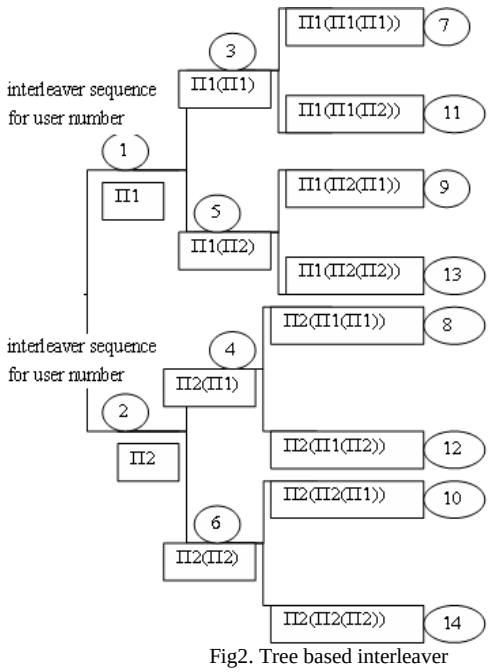

Fig2. Tree based interleaver

III. MULTIPLE ACCESS SCHEMES

a)FDMA

FDMA is a channel access method used in multiple access protocol as a channelization protocol.FDMA gives user an individual allocation of one several frequency band for channel. In FDMA all user share the satellite transponder or frequency channel simultaneously but each user transmit single frequency.

b)TDMA

TDMA is a channel access method for shared medium network.it allows several user to share the same frequency channel by dividing the signal into different time slot.TDMA is used in the digital 2G cellular system such as global system for mobile communication.

C) CDMA

In Frequency Division Multiple Access (FDMA), the total system bandwidth is divided into frequency channels that are allocated to the users. In Time Division Multiple Access (TDMA), each frequency channel is divided into time slots and each user is allocated a time slot. But in CDMA each user is assigned a unique 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.

One of the main advantages of CDMA systems is the capability of using signals that arrive in the receivers with different time delays. This phenomenon is called multipath. FDMA and TDMA, which are narrow band systems, cannot discriminate between the multipath arrivals, and resort to equalization to mitigate the negative effects of multipath. But the performance of CDMA system is mainly limited by multiple access interference (MAI) and Inter symbol Interference (ISI) and it also does not provide much high data rate as user expect for the transmission. .

CDMA (Code Division Multiple Access) is a communication technique that allows multiple users to communicate simultaneously over one frequency. This is achieved through the use of *spreading codes*, whereby a single data bit is "spread" over a longer sequence of transmitted bits. These codes, known as *chip sequences*, must be carefully chosen so that the data may be correctly "despread" at the receiver. Such codes are known as*orthogonal* codes.

e) IDMA

Interleaver division multiple access (IDMA) is a technique that relies on different interleavers to separate signals from different users in a multiuser spread-spectrum communication system. In [1], an IDMA system that uses randomly and

independently generated interleavers is presented. With these interleavers, the IDMA system in [1] performs similarly and even better than a comparable CDMA system.

The condition for IDMA to be successfully implemented is that the transmitter and receiver agree upon the same interleaver. For random interleavers, the entire interleaver matrix has to be transmitted to the receiver, which can be very costly. Our goal is to construct nonrandom interleavers for IDMA that perform as well as random interleavers and satisfy two design criteria: With simple, They are easy to specify and generate, i.e., the transmitter and receiver can send a small number of bits between each other in order to agree upon an interleaver, and then generate it. The interleavers do not "collide".

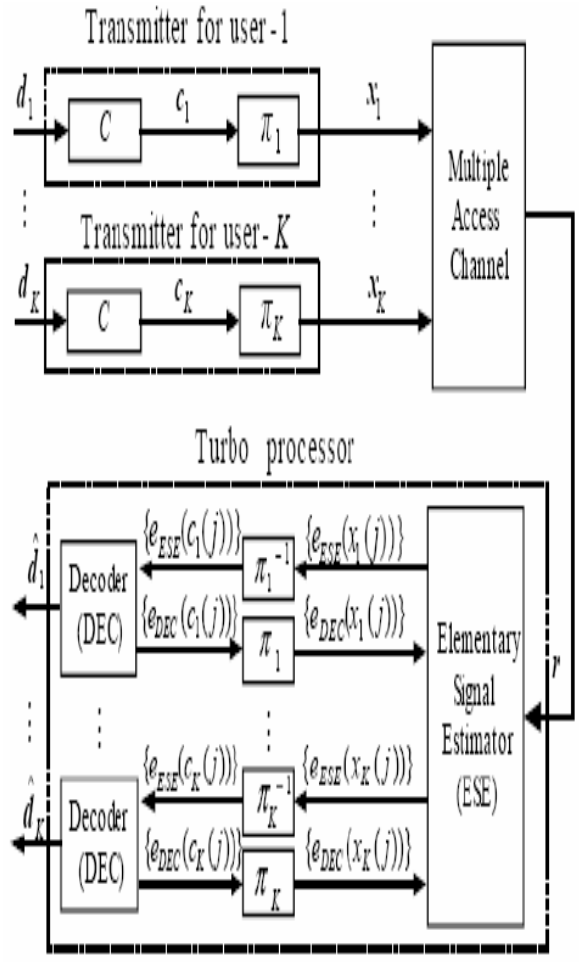

Fig 3.Transmitter and reicever of idma

The receiver structure consists of an elementary signal estimator (ESE) and K single-user a posteriori probability (APP) decoders (DECs). The multiple access and coding constraints are considered separately in the ESE and DECs.

The outputs of the ESE and DECs are extrinsic log-likelihood There are many burning issues in the field of research inInterleave Division Multiple Access. Some of them are listed below:

1. Signalling schemes in multipath fading channels
2. Optimum coding Technique
3. Variation in Interleaver design
4. Power Control Algorithms

a)Signaling schemes in multipath fading channel

The IDMA scheme with BPSK and QPSK modulation schemes. In both the scheme, the improvement in BER has been observed in comparison to CDMA. The QPSK scheme is always preferred to BPSK scheme in terms of better bandwidth utilization even if the BER performance is comparable to that of BPSK. Benefit including low-cost MUD for system for large users, high spectral efficiency and near limit performance.

b) Optimum coding technique

With simple convolution/repetition codes, overall throughputs of 3 bits/chip with one receive antenna and 6 bits/chip with two receive antennas are observed for systems with as many as about 100 users. More sophisticated low-rate codes can also be used for further performance enhancement, as illustrated by comparison between low-rate and high-rate coded IDMA systems.

IV. Comparison between RI, MRI, TBI

Parameter	RI	MRI	TBI
Memory requirement	High	**Low**	**Low**
Bandwidth requirement of Interleaver(30 users)	$1.5x10^6$	$0.01x10^6$	$0.02x10^6$
Complexity	High	Very high	Low
Specific user cross correlation	Low	Low	high

V. CONCLUSION

In this paper, comparisons between different Interleavers have been made on the basis of parameters like complexity, bit error rate (BER), memory requirement etc. Among all the comparisons discussed so far, the features of Tree Based Interleavers and Prime interleavers

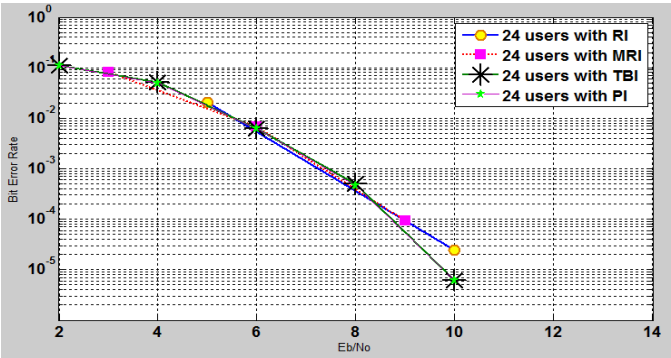

Fig5. Graph Showing Computational Complexity
between Random Interleaver, and Tree Based Interleav

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