Performance of LDPC and CONVOLUTION Coded Interleave Division Multiple Access(IDMA)System

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Abstract- **In recent days, on the horizon of wireless world, newly proposed multiple access scheme known as Interleave-Division Multiple-Access (IDMA) . A method to enhance the performance of IDMASystem Low density parity check (LDPC) codes can be applied to IDMA system, called LDPC-Coded IDMA System, which is presented recently for combing the advantages of LDPC and IDMA. We use regular LDPC coder is used.**

In this paper we compare coded and uncoded IDMA environment. Performance of coded LDPC-IDMA is using with random interleaver & tree based interleaver. During the simulation, it has been observed that tree based interleaver demonstrate the similar bit error rate (BER) performance to that of random interleaver and also compare to half rate ldpc and convolution coder using Random and Tree based interleaver using BPSK modulation technique in AWGN environment. This paper shows that ldpc-idma is better compare to convolution coder.

Key Words-IDMA**, LDPC codes, iterative receiver, random interleaver, tree based interleaver.**

1.INTRODUCTION

Multiple access as one of the most key technologies in wireless telecommunication field has been widely researched. As we all know, turbo-type iterative multi-user detection (MUD) has significant effect on mitigating intersymbol interference (lSI) and multiple access interference (MAl) which greatly restricts the performance of multiple access wireless systems.

A conventional CDMA system involves separate forward error correction (FEC) codes and spreading operations. However, according to theoretical analysis, combining FEC and spreading operations, which releases all the bandwidth to channel coding, has been demonstrated to achieve optimal multiple access channel(MAC) capacity and to maximize coding gain. Interleave Division Multiple Access (IDMA) scheme in which interleavers are employed as the only means of user separation. Interleave division multiple access (IDMA) is a special case of random waveform CDMA, and the accompanying chip-by-chip (CBC) estimation algorithm is essentially a low cost iterative soft cancellation technique The chip-by-chip (CBC) MUD algorithm for IDMA is an iterative soft cancellation technique for treating multiple access interference (MAI). Its computational cost is very low, being independent of the total number of users when normalized to each user.

Low density parity check (LDPC) codes are excellent error correcting codes and its Performance comparison between LDPC-Coded and Convolutional-Coded IDMAunder AWGN and environments if power attribution is not considered advantage of purposed system This paper is organized as follows. System model for LDPC Coded IDMA is introduced in Section 2. In Section 3, computer simulation results are given and the performance of the proposed system is also analyzed. Section 4 contains the conclusions.

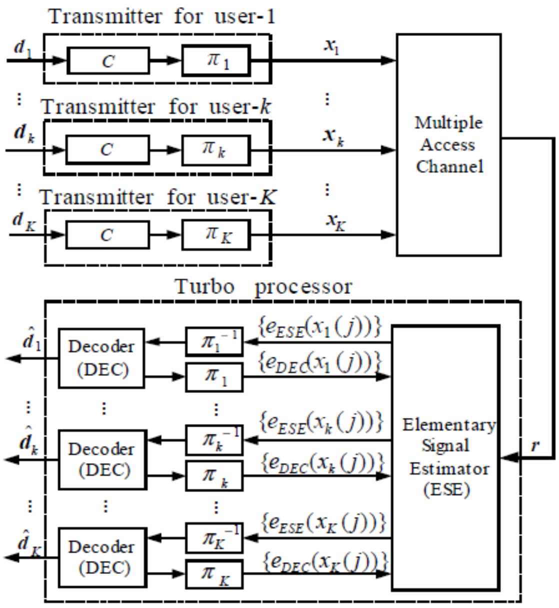
2. TRANSMITTER STRUCTURE

The upper part of Fig. 1 shows the transmitter structure of the proposed system under consideration with K simultaneous users. The input data sequence $d^{(k)}=\{b_n^k\}$,n=l, ...,N} of user-is encodedbased on a LDPC code C with coding rateR,

so as to generate sequence b(k) $=\{b^k\}$,m =1,...,M}, where M=N/R. And then the coded sequence b(k) is spreaded using a length-S spreading sequence $S^{(k)}$ into $C^{(k)} =\{c_j^{k)}$, j =1,...,J} , where J=MxS is the frame length . A chip level interleaver $\pi^{(k)}$ is applied , producing the transmitted signals$X^{(k)} = \{x^k_j)$, j = l ,...,J}.interleavers $\pi^{(k)} = \{ \pi^k_j)$, k = l ,...,k}.for user separation. The interleavers are generated for differently and randomly.

***3**. Receiver Structure*

The sub-optimal receiver structure is illustrated in the lower part of Fig.I. In the receiver part, an Elementary Signal Estimator (ESE) and K single-user a posteriori probability (APP) LDPC decoders (DECs) are applied to solute the multiple access channel constraint and the code constraint separately[2]. This greatly reduces the complexity involved in the receiver.



$$r(j)=\sum_{k=1}^{K}h_k x_k(j)+n(j) \qquad j=1,2,\ldots,J,$$

Where $x_k(j)$ is the j th chip transmitted by the K th user, the channel coefficient for the K^{th} user and {} samples of a zero-mean additive white Gaussian noise (AWGN) with variance $\sigma^2=N0/2$.

The receiver operation is still based on two constraints: (i) the constraint of the FEC code C and (ii) the constraint due to the superposition of the transmitted chips.

The receiver consists of an elementary signal estimator (ESE) and k a posteriori probability (APP) decoders (DECs), operating iteratively. For each user k, we rewrite (1) as;

$$r(j)=h_k x_k(j)+\xi_k(j)$$

$\xi_k(j)$ is the distortion (including interference-plus noise) in (r_j) with respect to user-k. From the central limit theorem, $\xi_k(j)$ can be approximated as a Gaussian variable, and
can be written as,

Fig.1 IDMA Transmitterand Receiver Dia.
At the receiver side the received signal

$$E(r(j))=\sum h_k E(x_k(j))$$

$$Var(r(j))=\sum_k |h_k|^2 Var(x_k(j))+\sigma^2$$

$$E(\xi_k(j))=E(r(j))-h_k E(x_k(j))$$

$$Var(\xi_k(j))=Var(r(j))-|h_k|^2 Var(x_k(j))$$

Step (iii) : LLR Generation

$$e_{ESE}(x_j^{(k)})=\frac{2h^{(k)}}{Var(\varsigma_j^k)}(r_j-E(\varsigma_j^k))$$

LDPC Codes

In this part we study about low density parity check (LDPC) coding scheme. Basically there are two different possibilities to represent LDPC codes. Like all linear block codes they can be described via matrices. The second possibility is a graphical representation graphical representation called Tanner graph. The decoding algorithm of LDPC codes can be easily understood by Tanner graph. Tanner graph specifies two types of nodes; bit nodes and check nodes representing the number of column and number of rows of a parity-check matrix H respectively. LDPC codes can be categorized as Regular LDPC codes and Irregular LDPC codes depending upon the weight of the parity–check matrix.

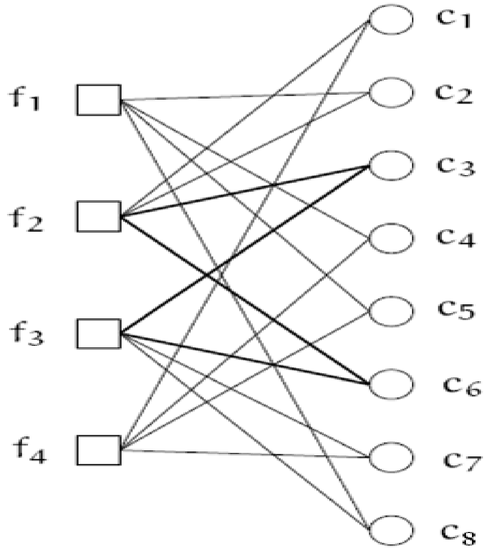


Fig 2.1 The (7, 4)Tanner Graph.

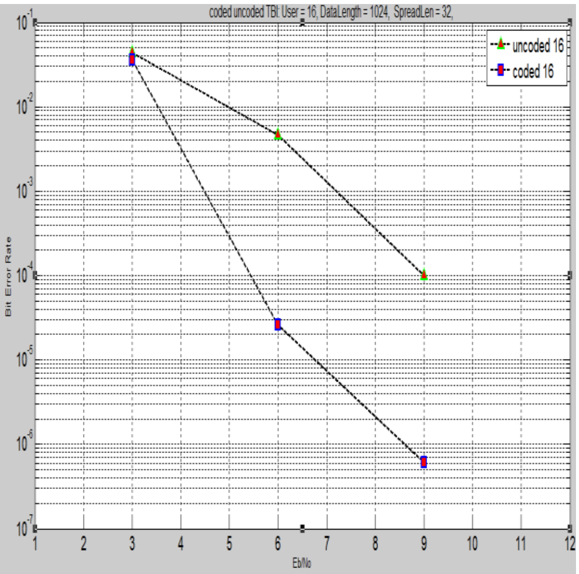
LDPC codes can also be defined by using a sparse parity-check matrix with dimension m x n as for generating (n, k) LDPC codes, where k= (n-m), n and m are the number of columns and number of rows of the parity-check matrix respectively. The LDPC code with code rate 'r', where r=k/n can be decoded by using a probability propagation algorithm known as sum product algorithm.

Consider a (4, 8) linear block code to illustrate the hard-decision decoder. The code is represented in Figure 1 its corresponding parity check matrix is sparse parity-check matrix as shown in below.

$$\mathbf{H} = \begin{bmatrix} 0 & 1 & 0 & 1 & 1 & 0 & 0 & 1 \\ 1 & 1 & 1 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 1 & 1 & 1 \\ 1 & 0 & 0 & 1 & 1 & 0 & 1 & 0 \end{bmatrix}$$

4. SIMULATION RESULTS IN IDMA SCHEME

to be 10, for iterative decoding at the receiver. The simulation is performed under AWGN environment with ½ rate convolution coding for simplicity we use the BPSK signaling. In IDMA scheme we Increase the data length ber performance is better in TBI in 32 user also compare with 16 user.



4.1 Simulation of TBI in coded and uncoded IDMA scheme.

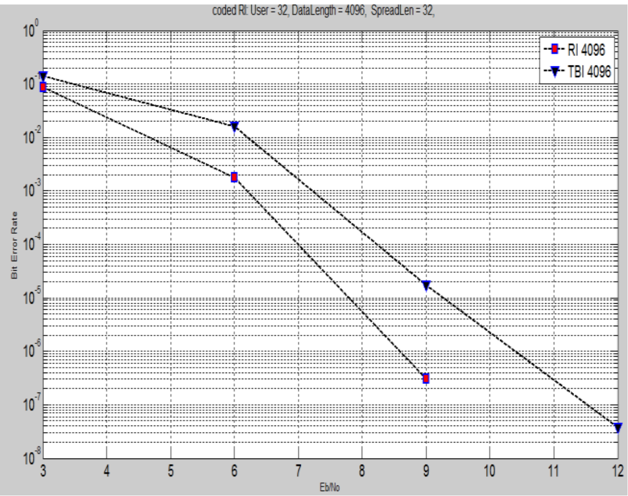


Fig. 4.2 Simulation results for 32 users Random interleaver and Tree based interleaver with data length 4096 convolution coding.

Fig 4.1 compare coded and uncoded tbi 16 user with 1024 data length in awgn environment using convolution coder.we show that the using the FEC coding ber performance is better than uncoded.

4.2, 4.3 presents comparative simulation of TBI, and RI for various data length of for 32 users. The spread length for all the users is taken to be 32 and 16 while the iteration count has opted

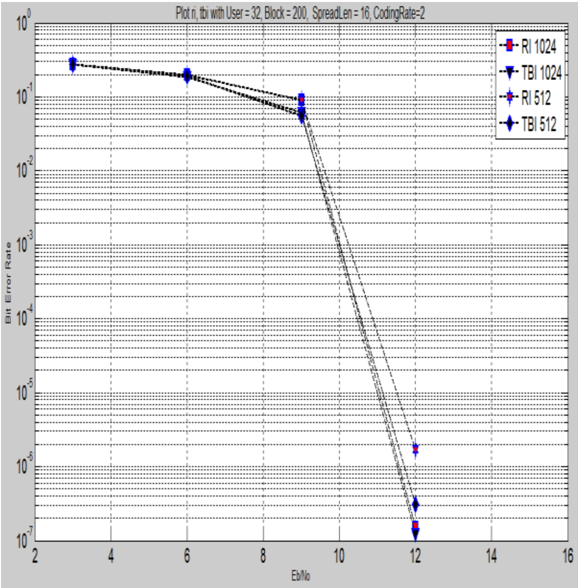


Fig 4.3 IDMASimulation results for 32 users Random interleaver and Tree based interleaver with spread length 16 and various data length using convolution coding.

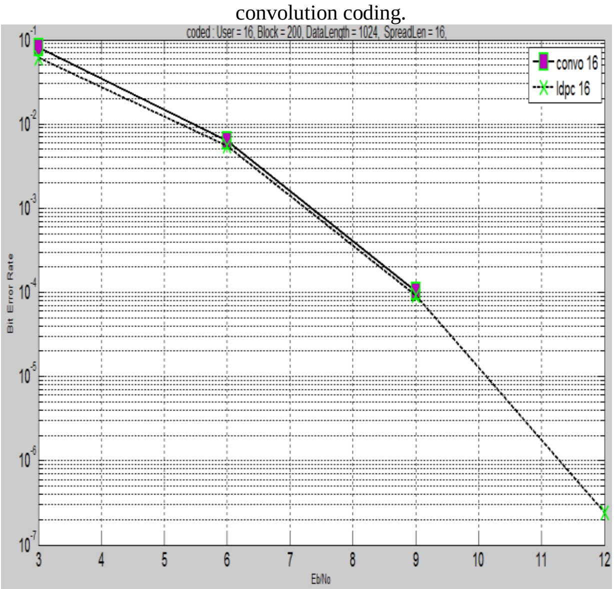


Fig.4.4 comparision of half rate ldpc and convolution of 16 user with data length is 1024, spread length is 16.

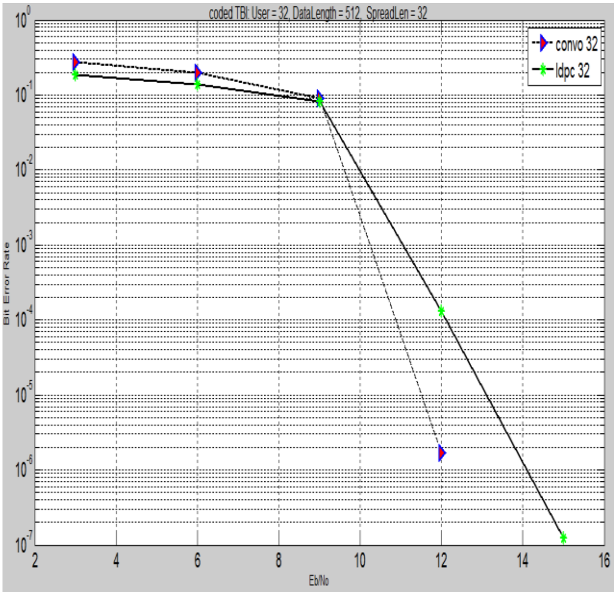


Fig. 4.5 comparisonof32 users with convolution coder and ldpc coder for Tree based interleaver with data length 512 and spread length is 32 using BPSK signaling.

Fig.3.4 shows the comparative analyses of IDMA CONVOLUTION and LDPC coder with TBI 32 user and spread length is 32 for data length is 512 and fig.3.5 is compared to 16 user and spread length is 16 for 1024 data length for RI and TBI. in the fig. shows that the ldpc is better BER performance is 10^{-7} and snr is much compared to convolution.

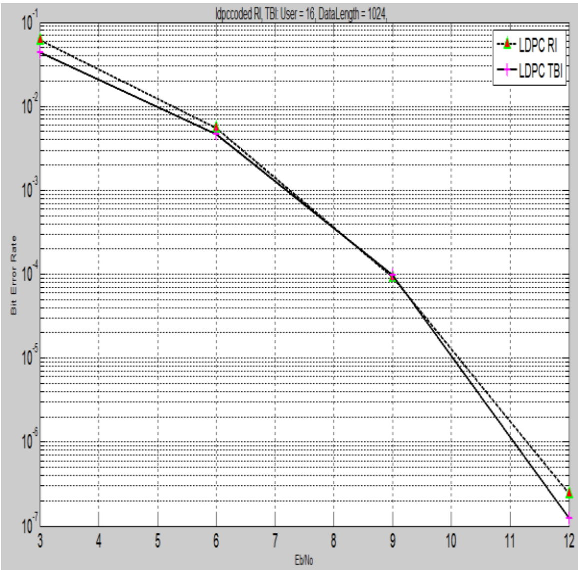


Fig.4.6 ldpc and convolution coder with 16 user with data length 1024 for Random and Tree based interleaver.

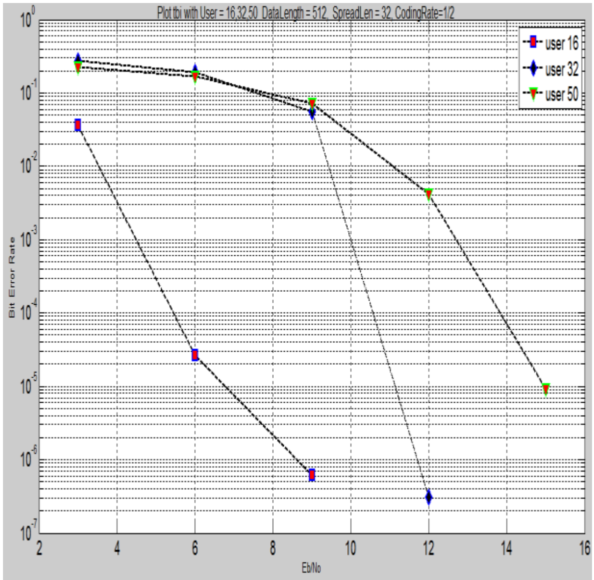


Fig 4.7 IDMA scheme for different user with coding using TBI, 512 data length.

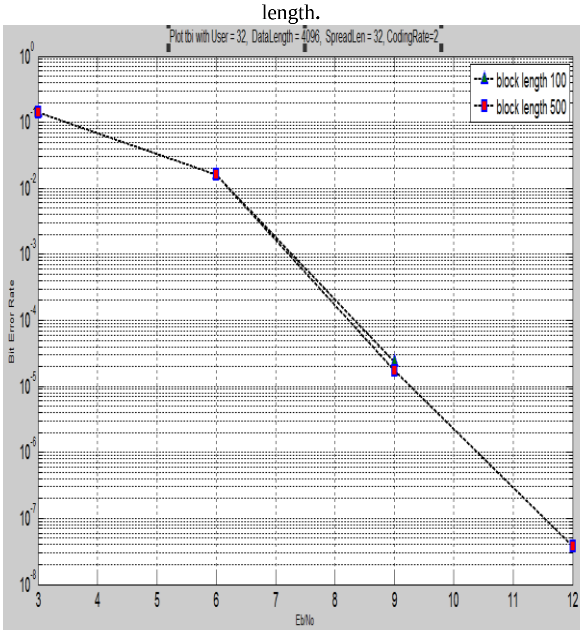


Fig. 4.8 shows that the 32 tbiuser with variable block length using convolution coder in AWGN environment.

In fig 4.8 we compare tbi 32 user with different block length including parameter is spread length is 32 and data length is 4096. In fig see that if the block length is increasing Bit Error Rate is good.

5.CONCLUSION

In this paper we present an IDMA system based on LDPC codes. LDPC is better compare to IDMA CONVOLUTION in terms of BER performance.And also I compare with Random and Tree base interleaver for various data length and different user .in fig shows data length is increases bit error rate is batter compared to small data length.

Tree based interleaver is similar to Random interleaver in terms of ber performance and advantages of tree based interleaver is if the increment of the user count computational complexity is lesser compare to RI and MRI and other interleaver.so TBI is better compared to RI and MRI. I compare coded and uncoded variable user count and achieved good ber.

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