

# Analysis of Various Parameters Used In CDMA and IDMA Techniques

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**Abstract** - This paper presents comprehensive comparisons of interleave division multiple access (IDMA) and Code division multiple access (CDMA) in terms of performance and complexity using iterative multiuser detection technique. It also exploits the interleaving as only means of user separation instead of by different signatures as in a conventional code division multiple-access (CDMA) scheme. The given scheme can achieve near single user performance in situations with very large numbers of users while maintaining very low receiver complexity. This technique shows that high performance can be maintained in multi-path environments. IDMA inherits many advantages from CDMA, such as diversity against fading and mitigation of the worst-case user interference problem. We also discuss several aspects of complexities for IDMA and DSSSS when the MMSE detector is used. Computer simulations are performed in various scenarios and the performance is analysed by bit error rate as well as by extrinsic information transfer chart. The analysis reveals some advantages of IDMA over CDMA, particularly in highly user loaded scenarios

**Keyword:** IDMA, CDMA, BER, ISI, MUD, MAI.

## I. INTRODUCTION

Multiple access technique is one of the key techniques in the wireless communication systems. Moreover efficiency and adaptability is the major features for the future mobile communications. These systems also require high spectral efficiency, high data rate, low power consumption and low consumption. There is several multiple access technique. But in this paper only CDMA and IDMA are studied and discussed.

### CDMA Scheme

Code division multiple access (CDMA) scheme is basically based on "spread spectrum" technology it has long been used for military purposes all over the world. In CDMA Scheme, spectrum capacity is increases because all the users are allowed to use all channels at same time. This scheme is affected to frequency selective fading which is caused by underwater multipath, but the performance of CDMA in underwater channel is almost limited by MAI and ISI. This CDMA method is used by several radio communication technologies and also referred as channel access method. CDMA has various transmitters which may send information/data over one communication channel simultaneously and it will permit users to share band frequency. CDMA uses special coding scheme and spread spectrum technology in order to allow the user to share bandwidth without any interference among the users. by using these schemes, every transmitter is assigned a code. IS-95 also referred as 'cdmaone' and its 3G evolution referred as CDMA2000 or simply means CDMA. But 3G standard used by GSM carriers may use wideband CDMA (WCDMA). CDMA has been played vital role in mobile telephony due to its properties which make it appropriate for civilian and commercial applications.

### IDMA Scheme

The necessity of another method for user separation has been solved by Interleave-Division Multiple-Access (IDMA) scheme, in which, most of above stated problems do not exist due to application of user-specific interleavers having low cross-correlation amongst them. The interleaved data resulted from user-specific interleavers, demonstrates better orthogonality amongst each other in the channel. The condition of orthogonality is maintained for reducing the risk of collision amongst the interleavers during communication process. In IDMA inter leavers as the only means in order to distinguish the users. Historical point of view, interleaving was employed in ordering block storage on disk-based storage devices including floppy disk and the hard disk systems. The primary preference of interleaving was to adjust the timing differences between the adjacent bits during data transmission between computer and storage media. Interleaving was very common prior to the 1990s, but, later, faded due to availability of high speed processors. Now-a-days, all the modern disk storage systems are not at all being interleaved. Multiple Access technique is one of the key techniques in the wireless communication system, especially in the cellular mobile communication systems. In communication systems, interleaving is commonly used to overcome correlated channel noise such as burst error or fading [2]. In interleaving mechanism, the input data streams rearranges itself such that consecutive data bits are split among different blocks and is swapped in a known pattern amongst them. At the receiver end, the interleaved data is arranged back into the original sequence with the help of de-inter leaver. As a result of interleaving, correlated noise introduced in the transmission channel appears to be statistically independent at the receiver and thus allows better error correction.

The interleaver based multiple-access scheme has been studied for high spectral efficiency, improved performance and low receiver complexity. This scheme relies on interleaving as the only means to distinguish the signals from different users and

hence it has been called interleave-division multiple-access (IDMA). IDMA systems inherits many advantages from CDMA systems, in particular diversity against fading and mitigation of the worst-case other cell user interference problem. Furthermore, it allows a very simple chip by chip iterative multiuser detection (MUD) strategy. The normalized MUD cost (per user) is independent of the number of users.

#### Advantage of IDMA

1. IDMA is capable of eliminating Interference.
2. It has increased diversity against fading.
3. Very low receiver cost.
4. De- centralized control (Asynchronous).
5. Optimal Capacity.

#### II.RELATED WORK

**Wojuola, Olanrewaju** et al. [1] in this paper, CDMA as signal encryption approach has been discussed. The proposed signal encryption approach is mainly used in military application. Because this approach has jam resistant property and also proposed technique can be used for data hiding from adversaries. Moreover military application has been used for the purpose of signal transmission.

**Rashid, Mohammad** et al [2] proposed the analysis of a Multiband Multicarrier CDMA UWB system for RFID applications. In CDMA Scheme, all the users are allowed to use all channels at same time due to which its spectrum capacity is increased. This scheme is affected to frequency selective fading which is caused by underwater multipath

**Poveda, Héctor** et al. [3] discusses a multi-(users, carriers, antennas) IDMA receiver: in order to solve the bandwidth scarcity issue. The primary preference of interleaving was to adjust the timing differences between the adjacent bits during data transmission between computer and storage media. In communication systems, interleaving is commonly used to overcome correlated channel noise such as burst error or fading. Multiple Access technique is one of the key techniques in the wireless communication system, especially in the cellular mobile communication systems. In interleaving mechanism, the input data streams rearranges itself such that consecutive data bits are split among different blocks and is swapped in a known pattern amongst them.

**Sonam Sharma** et al. [4] described a survey of IDMA with different interleavers. The IDMA scheme employs the interleavers as the only means of user separation in order to ensure privacy related to data of users. With IDMA scheme, user separation is achieved with the help of user-specific interleavers, having low cross-correlation amongst them. As the spreader user data is fed to the user-specific interleavers, it results in better orthogonality between resultant interleaved data in the channel.

**Kusume, Katsutoshi** et al. [5] in this work, comparison of interleave division multiple access (IDMA) and direct sequence code division multiple access (DS-SS) has been presented in terms of performance and complexity using iterative multiuser detection technique, where we restrict ourselves to three suboptimum linear detectors: minimum mean square error (MMSE), rake (or matched filter), and soft-rake detectors from practical concerns.

**De Rango** et al. [6] paper discusses about a high level channel model based on Markov Chain approach for the underwater environment. Finite State Markov model is developed for Packet Error Rate (PER) evaluation in an underwater channel, using the concept of error trace analysis. Some high level models well known in literature are compared to obtain statistical evaluations in order to find the model best fitting the underwater channel dynamics. Simulation and analysis are made in MATLAB.

Table 1: Comparison of CDMA and IDMA on the basis of parameters

S.NO	PARAMETER	CDMA	IDMA
1.	ISI(Inter Symbol Interference) & ICI(Inter Channel Interference)	Can be overcome but it becomes difficult to avoid due to the use of MAI	Interference can be eliminated
2.	Multi user detection (MUD)	Difficult to eliminate	It can eliminate more efficiently
3.	MAI	Increase the complexity and reduce system performance	Better efficiency since it is used along with chip – level interleavers
4.	BER	IDMA due to MUD problem	Very good BER due to the use of interleavers
5.	Throughput	Low throughput	Comparatively high throughput.

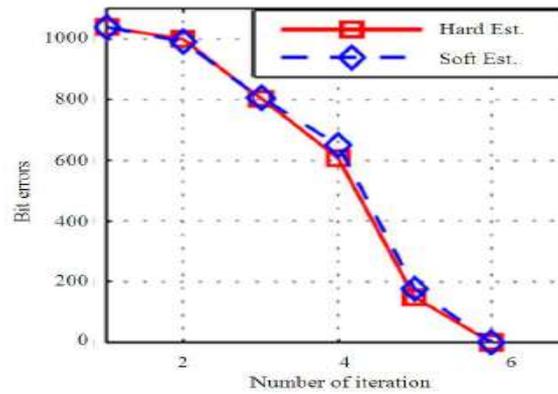


Fig.1: CDMA BER

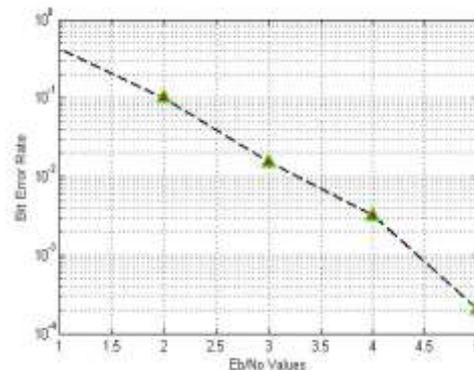


Fig. 2: IDMA BER

### III. CONCLUSION

This paper compares CDMA technology and IDMA technology which has been interleaved-division multiple-access (IDMA) that has been catching the attention in wireless circles. Visualizing the apparent difference between CDMA and IDMA schemes, it is observed that ordering of interleaving and spreading is reversed in IDMA scheme. In conventional CDMA scheme, the spreader is user specific, whereas in IDMA scheme, the interleaver is user-specific. In addition to it, in IDMA scheme, forward error correction (FEC) and spreading is combined in a single encoder (ENC), which is same or different for all users. As a consequence, very low rate encoding is used for forward error correction coding. The spreader has no fundamental relevance any more in IDMA systems. The spreading of data may be used to simplify the overall encoder. The interleaver is interpreted as a keyword and only authorized receivers are able to decode the message. It is suggested in the approach that for lower count of users, CDMA may be used while for higher user count, IDMA scheme may be utilized.

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