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RESEARCH ARTICLE

Performance Comparison for Different Modulation using MUD-MRC Technique in Wireless Communication

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ABSTRACT

In wireless communication signal strength is reduced due to so many factors such as interference, fading, scattering etc. Multiuser detection (MUD) technique is used to remove interference and space diversity techniques are used to increase the signal strength. In this paper maximum ratio combining technique is used as a space diversity technique and compares the performance of wireless system for number of users using MUD-MRC with different modulations technique.

Key words: *WCDMA, Multiuser detection, Maximum ratio combining.*

INTRODUCTION

Fading and multiple-access interference (MAI) are two factors that degrade the performance of multiuser system. There are a number of techniques which are used to mitigate these problems. In particular, multiuser detection (MUD) can be used to tackle MAI, while antenna diversity technique is used to eliminate fading problem. In this diversity technique information symbols pass through multiple signal paths, each path has strong and weak signal and can say different signal to noise ratio. The received signals are then added together and send to the demodulator. There are three main antenna diversity techniques such as selection combining (SC), equal gain combining (ECG) and maximum ratio combining (MRC). MRC technique is best method compare to other combining techniques to reduce fading (Ebrahimi and Bakhshi, 2009). Here used combination of MUD and MRC to reduce MAI and fading shown in Fig.1. In WCDMA system multiple access interference (MAI) is also reduces the performance of the system. MAI problem is very small for a single user, but this problem increases when the numbers of users are increased. So MAI plays a very important role in wireless communication (Duel-Hallen, *et al.,* 1995).

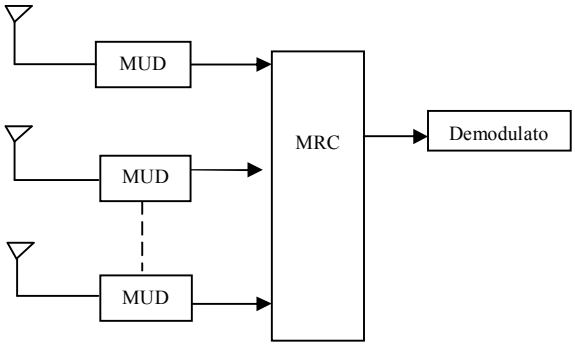

Fig. 1: Receiver block diagram for desire user

There are two main approaches to remove interference problem. The first approach is single user detection, and second approach is multiuser detection. In first approach, only the user who has strongest signal is considered as a desired signal and considers all other users as interference. The receiver (for the desired user) accepts only the desired user signal that has

strongest signal. In second approach phase and amplitude information of multiple users are jointly used for detection of signal of individual user (Louis G.F. Trichard, 2005). Multi-user detection (MUD) techniques also called interference cancellation (IC) and joint detection technique which is use to overcome the effects of multiple access interference and increase the performance of the system (Sen, *et al*., 2010).

The next section presents the multiuser detection techniques with MRC technique. Section 3 represented the simulation results and discussion the final section concludes the paper and presents the future work.

MULTIUSER DETECTION

The main function of Multi User Detection (MUD) technique is to cancel the interference caused by undesired users. This can be done by using the available information of the interfering users, rather than ignoring the presence of other users like in Single User Detection (SUD) technique (Olavarrieta, 2005). If two or more signals reached at a receiver simultaneously, only the strongest signal can be decoded and treating the other signal as an interference. Successive interference cancellation multiuser detection technique provides recovery of the weaker signal. In this technique first of all we decode strongest signal and after that subtract this signal from combined signal. The bits of the weaker packet are then decoded from the remaining packets (Prasad and Ojanpera, 1998). This can be a frequentative process to recover multiple signals as shown in Fig.2.

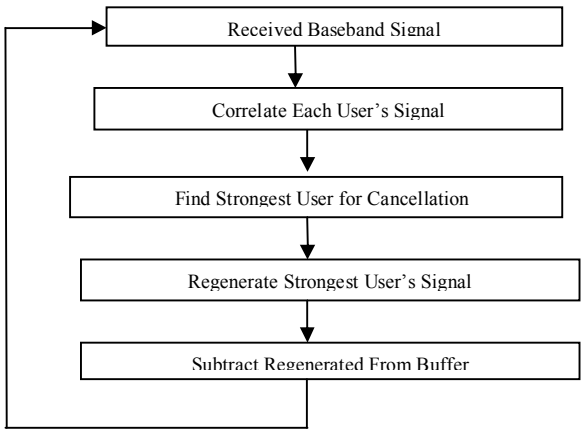

Fig. 2: The Flow chart of MUD

MAXIMUM RATIO COMBINING

When signal is passing through any obstacle like trees, buildings signals get faded. In this condition performance of the system will be affected and can say degraded. Capacity of the system can be increase using antenna diversity techniques. In this method when the signal pass through multiple path most of the path signal getting deep faded but there is a probility to get strong signal in another path. Now signal strength can be improve by combining techniques. There are three main combining techniques (1) selection combining (SC) (2) equal gain combining (ECG) (3) maximum ratio combining (MRC). In Selection combining it selects the branch that has maximum signal to noise ratio but the branch does not have sufficient signal to noise ratio which is less than some specific SNR threshold and in equal gain combining the outputs of different branches are first co-phased and equally weighted and after that added together. In equal gain combining for equally gains this technique require automatic gain controller that's why we don't prefer this technique (Haykin & Moher, 2005 and Clarke, 1968).

In maximum ratio combining (MRC) diversity technique, all the branches are used at the same time. Signals from each branch that is weighted with a gain factor which is proportional to the rms signal level and inversely proportional to the mean square noise level in that branch are

added together (Zhou and Okamoto, 2004). That signal can be used as a received signal and connected to the demodulator (Gordon, 1996 and Annamalai, *et al*., 1999).

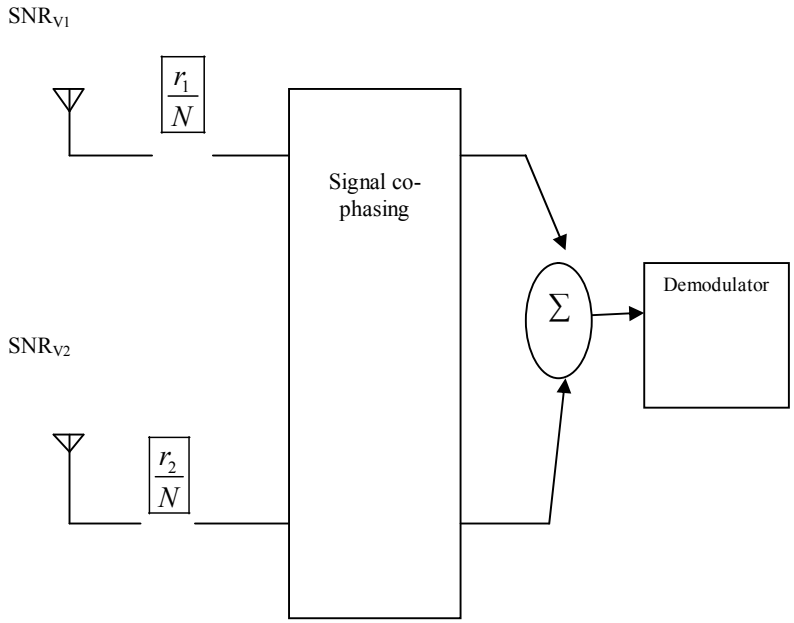

Fig. 3: Block diagram of a maximum ratio combining technique

$$\text{MGC } o\text{utput(dB)} = \text{SNR1} + \text{SNR2}$$

SIMULATION RESULTS AND DISCUSSION

In simulation results bit error rate (BER) is calculated with the Rayleigh fading and AWGN channel for the different number of users such as 4, 6, 10 and 15. The graphs for different user are presented in Fig. 4 to 11. In this graphs we check the bit error rate using MUD-MRC technique with dual antenna at receiver for different user in WCDMA system. In this simulation we use two different modulation methods those are QPSK and BPSK. Type 1 is BER analysis of MUD-MRC using QPSK modulation technique and Type 2 is BER analysis of MUD-MRC using BPSK modulation technique.

Type 1- BER analysis of MUD-MRC using QPSK modulation for different number of users:

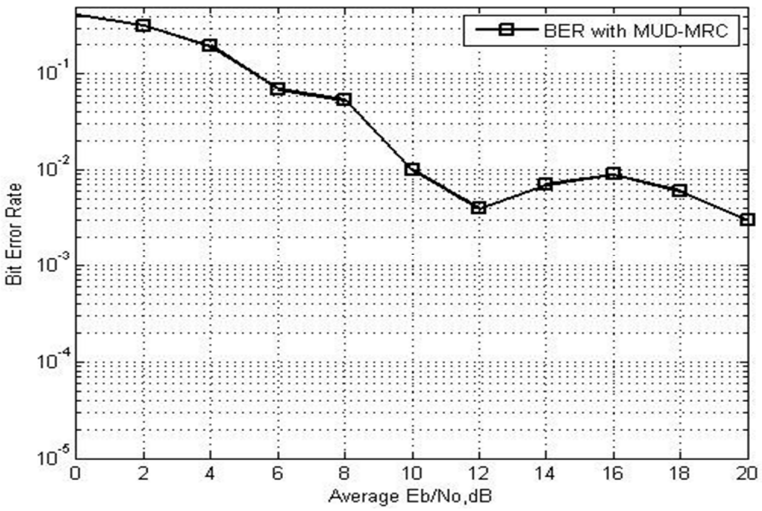

Fig. 4: BER with MUD-MRC for 4 users

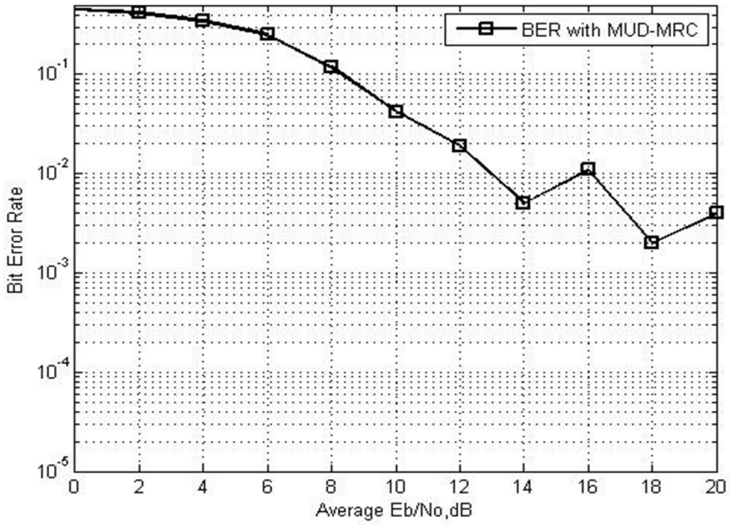

Fig. 5: BER WithMUD-MRC For 6 Users

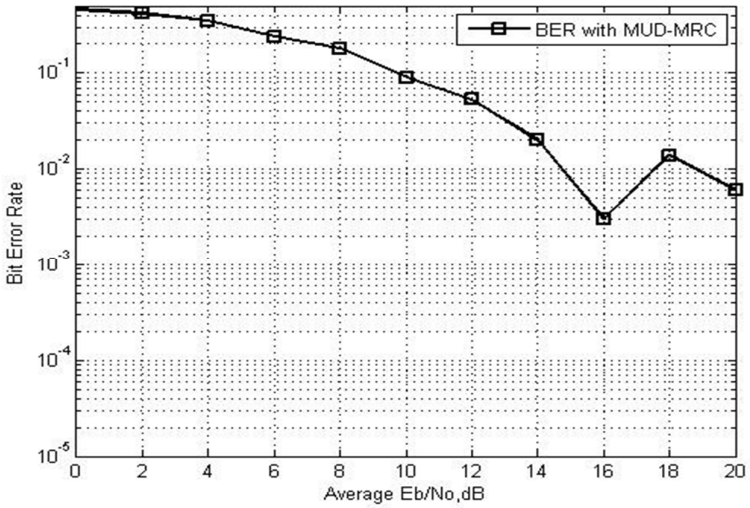

Fig. 6: BER with MUD-MRC for 10 users

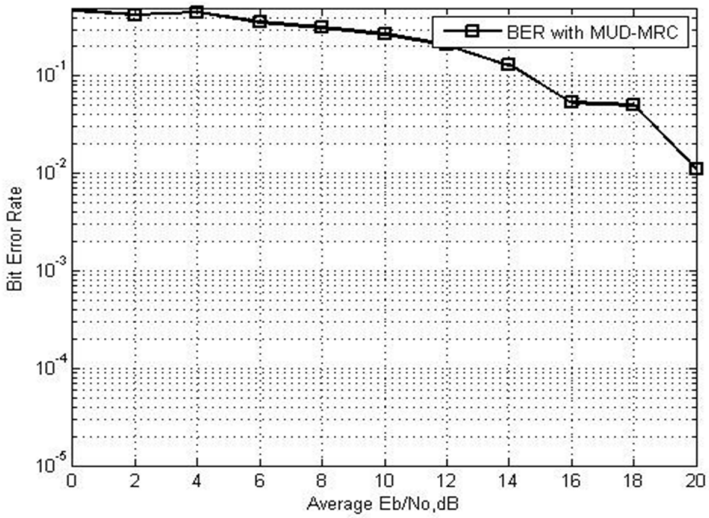

Fig. 7: BER with MUD-MRC for 15 users

DISCUSSION

Above given curves show the result of BER analysis of MUD-MRC using QPSK modulation technique for different users. All the results are calculated for nRx= 2 antenna at the receiver side. From Fig.4 it is clear that BER is around 0.4720 and at the higher value of Eb/No, the BER is reduced to 0.0030 for Eb/No=10 dB with 4 users. For 6 users initially the BER is around 0.4810and at the higher value of Eb/No, BER is reduced to 0.0070 for Eb/No=10 dB shown in Fig.5. From Fig.6 initially the BER is around 0.4840and at the higher value of Eb/No, the BER is reduced to 0.0100 for Eb/N=10 dB with 10 users. For 15 users the BER is getting 0.5040and at higher value of Eb/No, the BER is reduced to 0.0610 for 10 dBEb/No shown in Fig.7. It is clear from the simulation results that the BER is gradually increased when number of users is increased.

Type 2- BER analysis of MUD-MRC using BPSK modulation for different number of users:

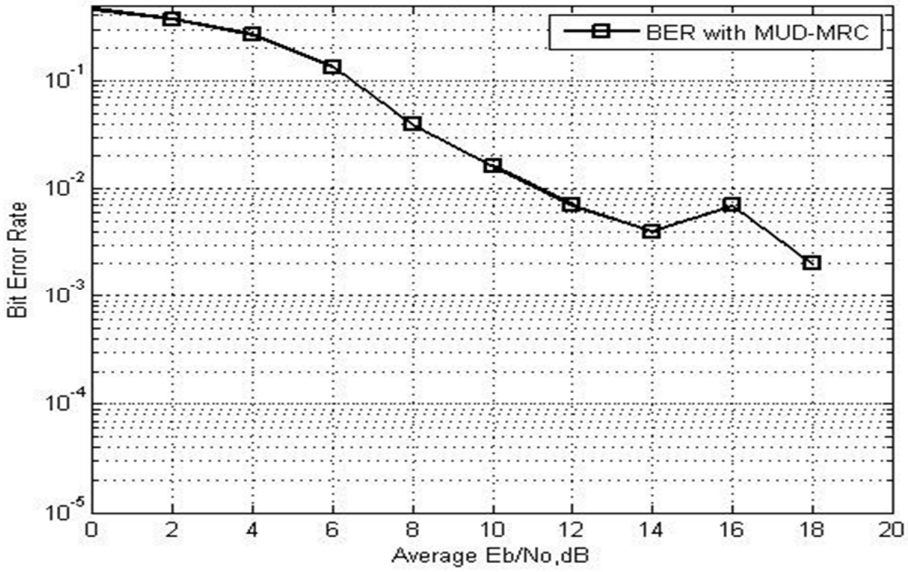

Fig. 8: BER with MUD-MRC for 4 users

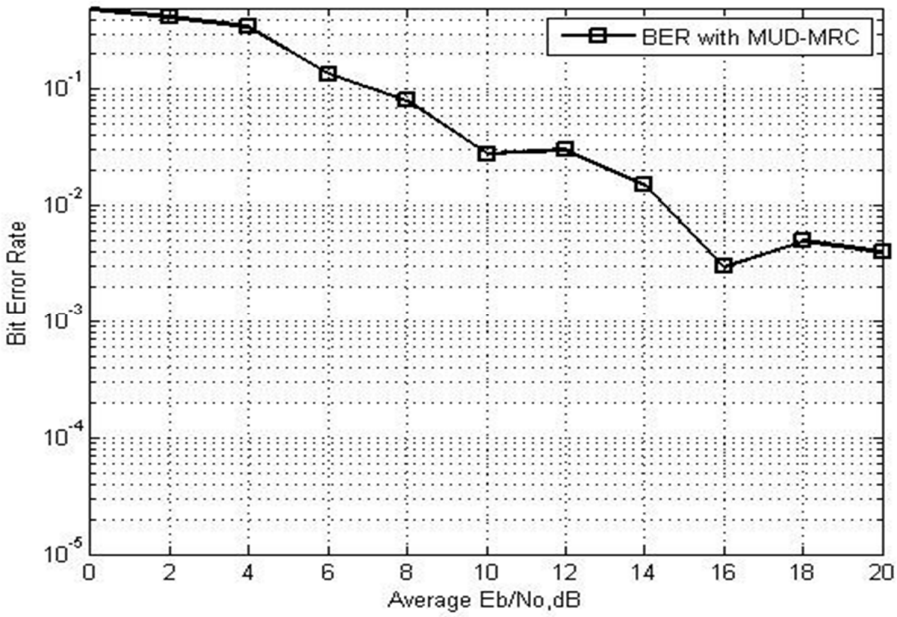

Fig. 9: BER with MUD-MRC for 6 users

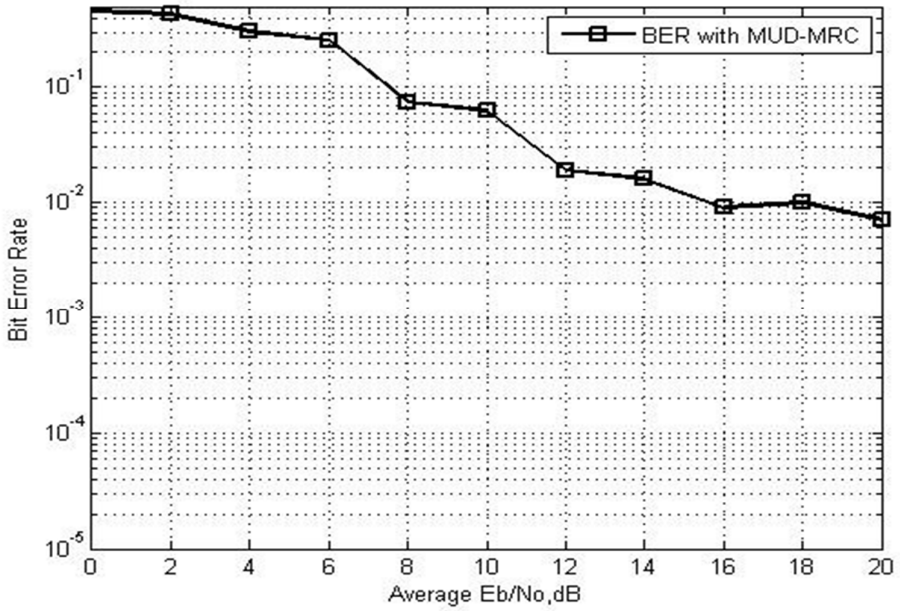

Fig. 10: BER with MUD-MRC for 10 users

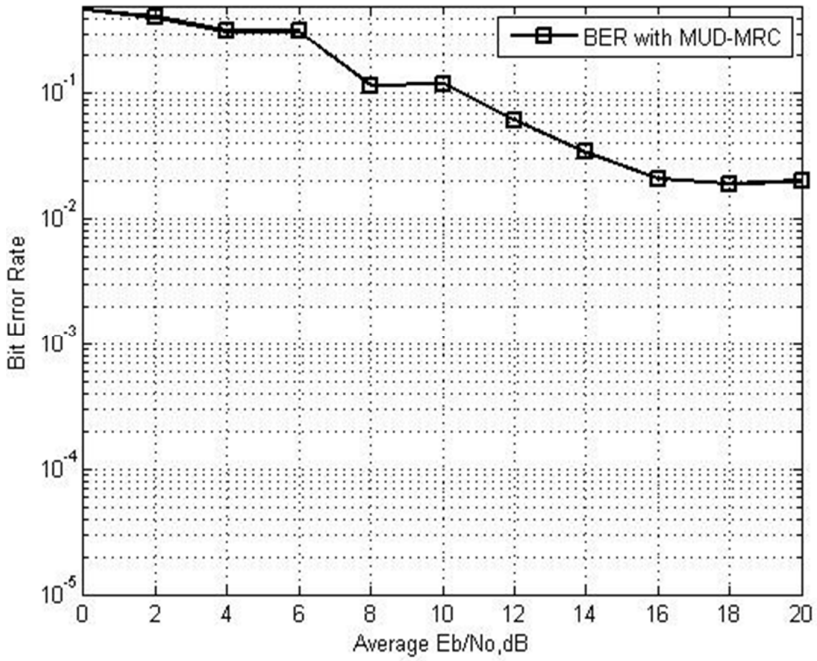

Fig. 11: BER with MUD-MRC for 15 users

DISCUSSION

Above given curves show the result of BER analysis of MUD-MRC using QPSK modulation technique for different users. All the results are calculated for nRx=2 antenna at the receiver side. From Fig.8 it is clear that BER is around 0.4570 and at the higher value of Eb/No, the BER is reduced to 0.0000 for Eb/No=10 dB with 4 users. For 6 users initially the BER is around 0.4610and at the higher value of Eb/No, BER is reduced to 0.0040 for Eb/No=10 dB shown in Fig.9. From Fig.10 initially the BER is around 0.4740and at the higher value of Eb/No, the BER is reduced to 0.0070 for Eb/N=10 dB with 10 users. For 15 users the BER is getting 0.4860and at higher value of Eb/No, the BER is reduced to 0.0210 for 10 dBEb/No shown in Fig.11. It is clear

from the results that the BER is gradually increased when number of users is increased and from the simulation results it is clear that performance for 4 users is good using QPSK and BPSK modulation technique.

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