Diversity Techniques for Improving the Bit Error Rate in Wireless Communication

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Abstract – One of the major drawbacks of one branch communication is poor performance, in terms of BER (bit error rate). In order to improve the performance of wireless communication system, we propose diversity techniques. This new scheme does not require any bandwidth expansion or any feedback from the receiver to the transmitter and it is computationally feasible. Fading can be mitigated by using diversity. Diversity techniques are broadly classified in to antenna, frequency and time diversity. This paper reveals how the antenna diversity can be used for obtaining better BER.

***Key Words*:** MIMO, Diversity, BER, Fading

I. INTRODUCTION

One of the key issues in wireless communication is fading [2]. The variation in the channel strength as a function of time, frequency is known as fading. In order to mitigate fading, diversity techniques are used. Diversity is a technique in wireless communication, where the information is sent through multiple paths. Hence, even though one of the communication link is in deep fade, the receiver can still recover the information that has been transmitted.

The most striking feature is that it does not require any bandwidth expansion. This technique does not require any kind of feedback from receiver to transmitter. The scheme may also be used to increase the range or the coverage area of wireless systems [7]. In other words, the new scheme is effective in all of the applications where system capacity is limited by multipath fading and, hence, may be a simple and cost-effective way to address the market demands for quality and efficiency without a complete redesign of existing systems.

The idea behind diversity is to send the same data over independent fading paths [3]. These independent paths are combined in some way such that the fading of the resultant signal is reduced. For example, for a system with two antennas that experience independent fading, it is unlikely

That both antennas experience deep fades at the same time. By selecting the strongest signal among the two antennas, we will obtain a much better signal than if we just had one antenna.

II. TYPES OF DIVERSITY

Diversity could be achieved in time, frequency, space.

A. Time Diversity:

In this scheme, the information is sent over multiple time slots. The probability that channel is in deep fade during all the time slots is very less. Time diversity helps in mitigating fading, bursts of error. The message is spread in time by means of bit interleaving.

B. Frequency Diversity:

The data is transmitted over a number of different frequency bands. This scheme proves to be effective, when the nature of fading channel is frequency selective. The strength of channel is varying, as the frequency of channel changes. However, it is a expensive technique, due to the difficulties in generating several transmitter signals and combining receiver signals at several different frequencies simultaneously.

C. Antenna Diversity

Instead of transmitting information over a single antenna, it is transmitted over several antennas [1]. Antenna diversity is further classified as transmit diversity and receive diversity. In transmit diversity, there are many transmitter antennas, but only one receive antenna. In receive diversity, there are many receiver antennas, but only one transmitter antenna. Depending upon the number of transmitter and receiver antennas, different scenarios are possible.

SIMO: Single transmit, multiple receive antennas.
MISO: Multiple transmit antennas, single receive antenna.
MIMO: Multiple transmit, multiple receive antenna.

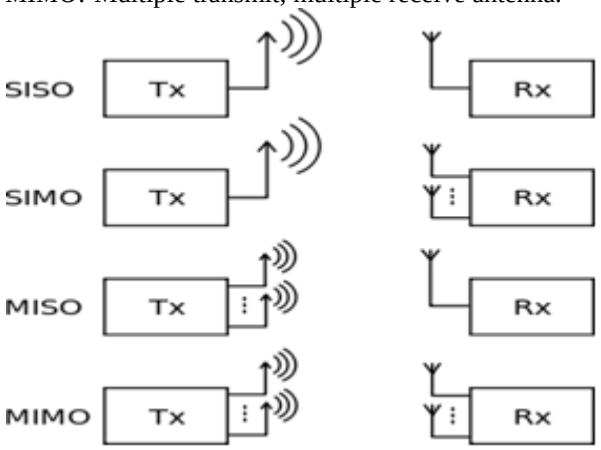

Fig. 1: Antenna Diversity schemes

III. SIMULATION RESULTS

Different scenarios under transmit diversity have been simulated in matlab software. A plot for Bit error rate versus Signal to noise ratio has been obtained for each case. Figure 1 shows the result for one transmit antenna, one receive antenna. Here, no diversity technique has been employedThe result shows that the BER is significantly higher. Under the low SNR cases, communication is erroneous.

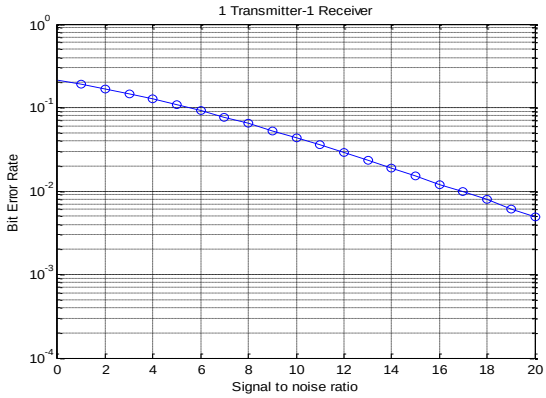

Fig. 2: BER versus SNR for 1 Tx-1Rx

Figure 2 and 3 shows the results for one transmit antenna-two receive antennas, one transmit antenna-three receive antennas respectively. The results reveal that as the number of receive antennas increases in Tx diversity, the BER performance improves.

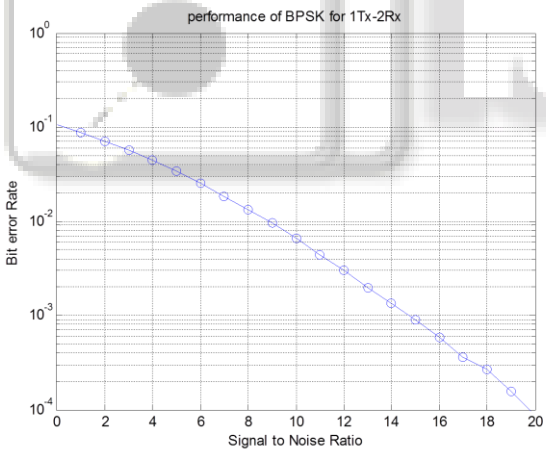

Fig. 3: BER versus SNR for 1 Tx-2Rx

Figure 4 shows the results for MIMO. Two transmit antennas, two receive antennas were considered for the purpose. It has a better performance when compared to earlier cases.

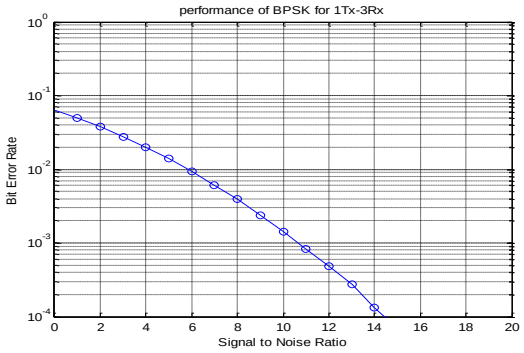

Fig. 4: BER versus SNR for 1 Tx-3Rx

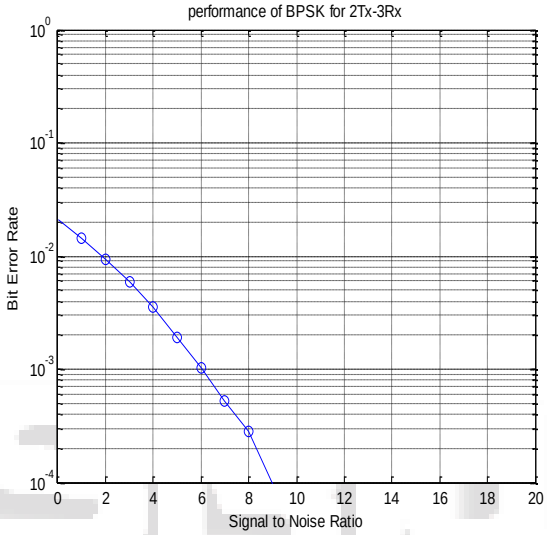

Fig. 5: BER versus SNR for 2 Tx-3Rx

IV. CONCLUSION AND FUTURE SCOPE

Diversity techniques significantly improves the Bit error Rate of wireless communication system. It mitigates the fading effect.

In this paper, we simulated the scenario of two transmitter antennas, three receiver antennas. However, in general, there can be 'n' number of transmitter antennas and 'm' number of receiver antennas.

REFERENCES

[1] Wei Liu , Sellathurai, Chaojing Tang and Jibo,"Achieving space and time diversity by using lattice constellation based joint Alamouti coding", International Journal of Advanced Research in Computer Science and Software Engineering, Vol. 14 , Issue: 1 ,pp-33 – 35, January 2010.

[2] Nitika Sachdeva, Deepak Sharma, "Diversity: A Fading Reduction Technique", Volume 2, Issue 6, June 2012.

[3] Simon, M. K. & Alouini, M. S. (2005). Digital Communication over Fading Channels, 2nd editiion, New York, Wiley.

[4] Hwang, K. S. at al.,(2008). Outage Probability of Cooperative Diversity Systems with Opportunistic Relaying based on Decode-and-foward, IEEE Trans on Wireless Communications, 7 (12), Part 1,pp 5100-5107.
[5] Xu, F. et al., (2009). Outage Performance of Cooperative Communication Systems using Opportunistic Relaying and Selection Combining Receiver, IEEE Signal Processing letters, 16(4), pp.237-240.
[6] P. R. Sahu, A. K. Chaturvedi, "Performance Analysis of Predetection EGC in Exponentially Correlated Nakagami-m Fading Channel", IEEE Transactions on Communications, VOL. 53, NO. 8, AUGUST 2005.
[7] Fangming He, Hong Man and Wei Wang, "Maximal Ratio Diversity Combining Enhanced Security", IEEE Communications Letters, Vol-15, Issue: 5 , pp-509 – 511, May 2011.
[8] Jayalakshmy et al., (2011). Performance, Analysis and Efficient Transmission over Multiple Wireless Channels using V-Blast Architecture, CIS Journal, 2, Special issue pp 11.
[9] Song, B. et al., (2009). Exploiting Multiuser Diversity for Fair Scheduling in MIMO Downlink Networks with Imperfect Channel State Information, IEEE Trans.on Communication, 57(2), pp.470-480.
[10] So, J. W. & Cioffi, J. M. (2008). Capacity and Fairness in Multiuser Diversity Systems with Opportunistic Feedback, IEEE Communications letters, 12(9), pp.648-650.

