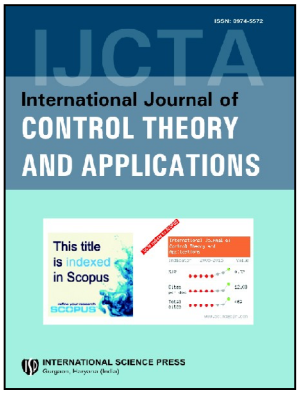

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Mimo Cognitive Radio Network Using Hybrid Amplify Forward And Decode Forward Technique For Future Wireless Communication Systems

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Abstract: In general transmitting data via wireless communication channel requires more power than the wired communication or in other words any communication through wireless medium will consume more power. Since power is a limited source we would strive hard to conserve it or reduce its usage and this leads to the concept of "Efficient power allocation scheme for MIMO (Multi Input Multi Output) cognitive radio" system. The proposed system consist of two algorithms for this, they are namely On/Off Base Scheduling (OOBS) and Selective Based Scheduling (SBS) in Amplify and Forward (AAF) and Decode and forward (DAF) techniques. OOBS algorithm is used for efficient allocation of the input power to each user's (SNR) Signal to Noise Ratio value, the proposed algorithm provides better power utilization with low bit error rate (9.53×10^{-7}).

Keywords: MIMO, Amplify Forward, Decode Forward, Efficient Power Allocation, On/Off Base Scheduling.

1. INTRODUCTION

In wireless network the major factor is demand of high data rate and high speed over wireless communication system. MIMO OFDM is a promising technique to achieve the high data rate in wireless communication channel. Single Input Single Output (SISO) communication systems are not much efficient and so new systems like MIMO are developed which are much more efficient than the SISO. The power requirement is much higher than the SISO system and error rate also will be high. So the cognitive radio network helps to allocate the power in efficient manner and reduce the bit error rate. Cognitive radio network takes decisions using the information about the RF environment through some models and past experiences. Spectrum sharing and wireless communications are the main objectives of cognitive radio network. There are two types:

1. Primary
2. Secondary

Where licensed persons are the primary users and the unlicensed persons is secondary users. Now a day the power allocation in MIMO cognitive network has to be efficient, since the power is limited resource.

There are many techniques for power allocation in MIMO cognitive radio system[1][2], such as fixed allocation, dynamic allocation, MA (Margin Adaptive) rate adaptive. The existing techniques for power allocation in MIMO networks are not effective in allocating the power efficiently. Hence we are proposing a new algorithm based on OOBS and SBS scheduling using hybrid AAF and DAF relay techniques.

2. METHODOLOGY

The proposed method for allocating power efficiently is based on AAF and DAF relay techniques using OBS and SBS algorithm. The input signal is the OFDM modulated signal[2]. In MIMO[3][4] cognitive radio network different users will have different SNR values. The OFDM modulated MIMO signals are transmitted through a Rayleigh fading channel i.e. 20 KHz.

(A) OOBS and SBS Algorithm

The OOBS (On/Off Base Scheduling) technique is used in this method allows only those signals which are above the predefined SNR values. The SNR of the each user compared with the predefined value and acceptable signals only pass through the channel. The SBS scheduling will allow the unacceptable signals if some part of the channels is ideal. These selection techniques will continue until the channel bandwidth utilization is full.

The power is efficiently allocated based on the SNR value of each user and given by the formula shown below

$$\text{Power} = (1/\text{SNR} * \text{initial power/no of user}) \quad (1)$$

The user with lowest SNR is allocated maximum power and the user with highest SNR allocated minimum power. The hybrid AAF and DAF relays are used for reducing the power needed for direct source to destination communication.

The MRC technique is used for selecting the appropriate relay techniques [5]. The MRC technique is used for achieving maximum SNR values by combining the individual SNR values.

The AAF technique is implemented between the relay to destination. The main aim of this technique is used to simply amplify the received signals [6][7] and it is used to boost up the received weak signals. Figure 1 represents the communication between source and destination.

(B) AAF and DAF

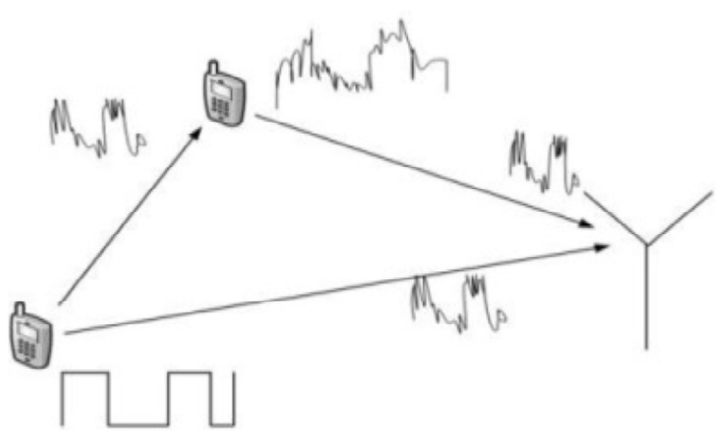

Figure 1: Source to destination communication

Figure 2 represents the block diagram of AAF, DAF and hybrid relay technique. A MIMO cognitive radio network is designed and the source and destination nodes are fixed along with some intermediate nodes. The intermediate nodes act as the relay. Here the signals are chosen based on the SNR value. If the signal's SNR value is greater than 20dB then those signals are acceptable, otherwise those signals are considered non-acceptable signals.

If the selected signal's bandwidth is equal to the channel bandwidth then all the signals are going through that channel to next level. If the selected signals bandwidth is not equal to the channel bandwidth then the channel bandwidth is not properly utilized. By using the SBS scheduling technique the un-utilized bandwidth is used in a proper manner. The un-selected signals are listed in descending order and the most priority signals like high SNR signals are selected and passed to the channel.

The signal selections are based on the SNR value and channel bandwidth.

The steps to be followed in the proposed technique are

Step 1: Random SNR Generation.

Step 2: Check the SNR value and choose the acceptable signals.

Step 3: Power allocation for each user depending on the SNR value

Step 4: Source to relay communication –DAF Relay to destination communication –AAF

Step 5: Final output.

The below graph explains the signal selection among the all other signals

3. PROPOSED MODEL

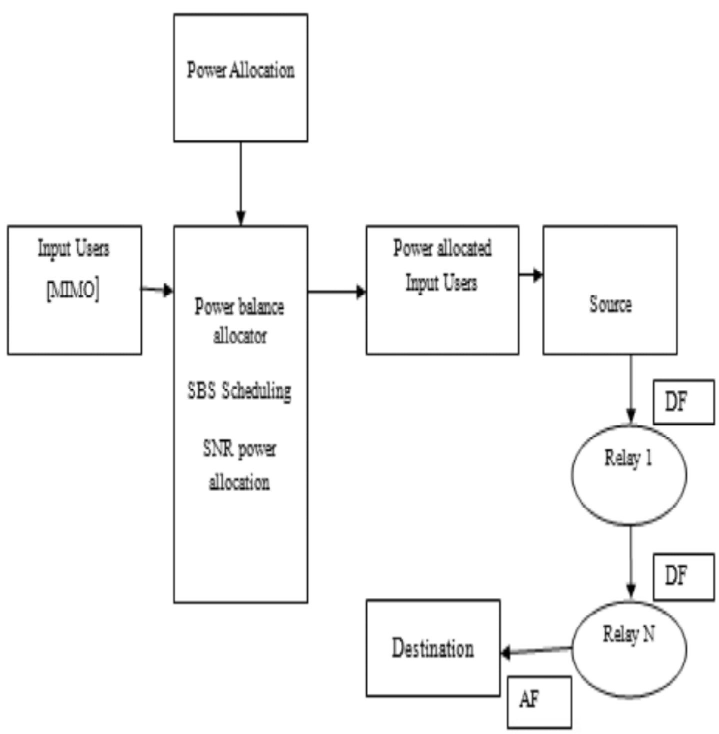

Figure 2: Proposed Hybrid Relay technique

In cooperative communication, to choose the relay or partner or a set of them, is the challenging task. The proper selection of the relay can effectively improve the overall performance of the network in terms of higher data rate/through put, lower power consumption and better bit error rate performance. The relay is based on the performance indices like Channel state information (CSI), Signal to noise ratio (SNR), Packet error rate (PER) etc. The relay is not to be selected by only considering the source to destination performance but it must be done by keeping the overall system performance in view.

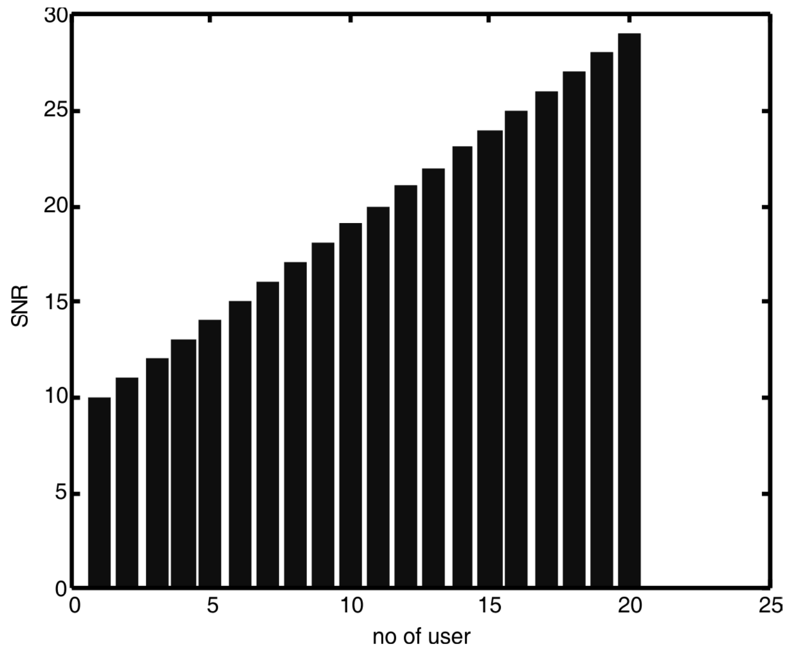

Figure 3: Input signals (no of users Vs SNR)

In figure 3, X-axis represents number of users, y-axis represents SNR value. From the graph we can easily find the each user's SNR value.

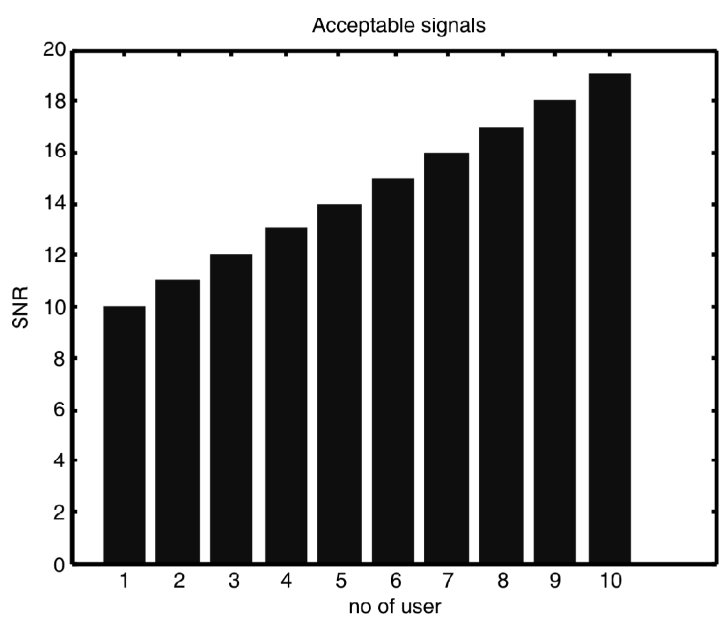

Figure 4: Acceptable signals (no of users Vs SNR)

From the figure 4 we can easily find the acceptable signals that can get eligible to go through the channel. If these signals are equal to the channel bandwidth, then the power is allocated to these signals depending upon the SNR value. After allocating the power the relay selection is done. There are many relay selection techniques which are already used, but here the MRC technique is used for relay selection. The congestion free shortest path from source to destination is found by using the routing algorithm. We design a network with 6 nodes. The source ID is node 1 and destination ID is node 6. From source to relay, DAF (decode and forward) technique is chosen.

This will help to reduce the error present in the transmitted signals, and retransmit to the next relay or destination. If the next node is a relay, then DAF is chosen else if the next node is destination, then AAF is chosen. AAF is mainly used to amplify the received signals.

Table I
SNR Vs Power Value

USER	*SNR (dB)*	*POWER VALUE*
1	20	5×10^{-3}
2	22	4.5×10^{-3}
3	24	4.2×10^{-3}
4	26	3.8×10^{-3}
5	28	3.5×10^{-3}
6	30	3.4×10^{-3}
7	32	3.2×10^{-3}
8	34	3.0×10^{-3}
9	36	2.7×10^{-3}
10	38	2.56×10^{-3}

Table I shows the power allocation of individual user. From this table we observe low power value is allocated for high SNR users and high power value is allocated for low SNR users.

4. RESULT & DISCUSSION

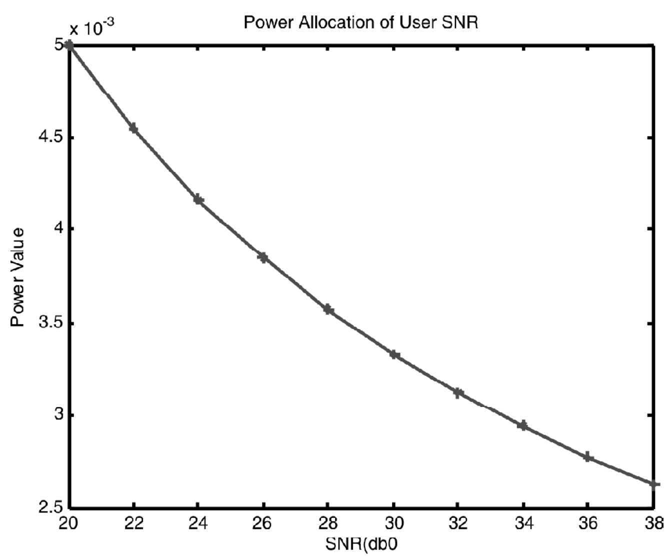

Figure 5: CDF Vs Link efficiency

In figure 5, the power allocation between the all users depending upon the each user's SNR value is represented. The X-axis represents the SNR value and Y-axis represents the power value. From our proposed method the total number of user is ten, among these 10 users the power is allocated depending on the SNR value. i.e. User 1 has low SNR value and so the high power is allocated for the first user. Similarly the power is allocated for all the remaining users.

In figure 6, X-axis represents the SNR value for each users and Y-axis represents the outage probability. In that figure, AAF has high Bit error rate compared to DAF and the DAF has less BER when compared to AAF. If we are using AAF for entire communication, then the BER will be very high. But if we are use DF only between the source and destination, then it will show less BER compared to AAF. So we implement Hybrid AAF and DAF technique between source and destination. It is shown from the graph that the BER is reduced compare with both AAF and DAF.

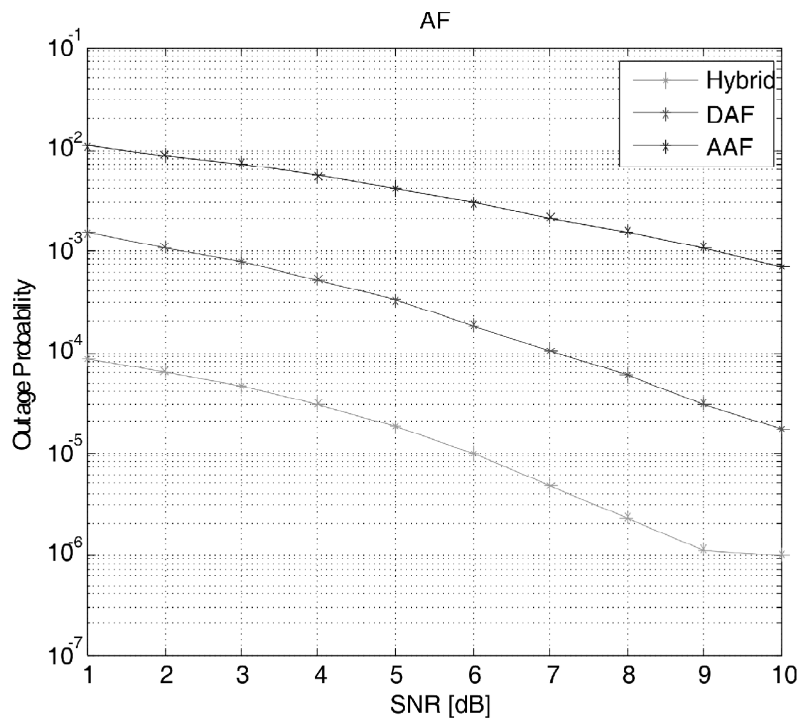

Figure 6: SNR Vs Outage Probability

Table II
SNR vs BER for AAF, DAF nad HYBRID

SL.NO	*SNR (dB)*	*BIT ERROR RATE*		
		AAF	*DAF*	*HYBRID*
1	1	0.01047	0.001381	0.0001016
2	2	0.008666	0.001035	7.057×10^{-5}
3	3	0.006961	0.000762	4.945×10^{-5}
4	4	0.005385	0.0005138	3.102×10^{-5}
5	5	0.003999	0.0003259	1.742×10^{-5}
6	6	0.002912	0.0001924	8.984×10^{-6}
7	7	0.002084	0.0001073	4.401×10^{-6}
8	8	0.001507	6.117×10^{-5}	2.135×10^{-6}
9	9	0.001048	3.073×10^{-5}	9.54×10^{-7}
10	10	0.000765	1.953×10^{-5}	9.53×10^{-7}

Table II compares the Bit Error Rate for all three AAF, DAF and Hybrid methods. The performance of Hybrid method is comparatively very good, and the error rate is improved i.e 9.53×10-7 for 10 dB SNR value.

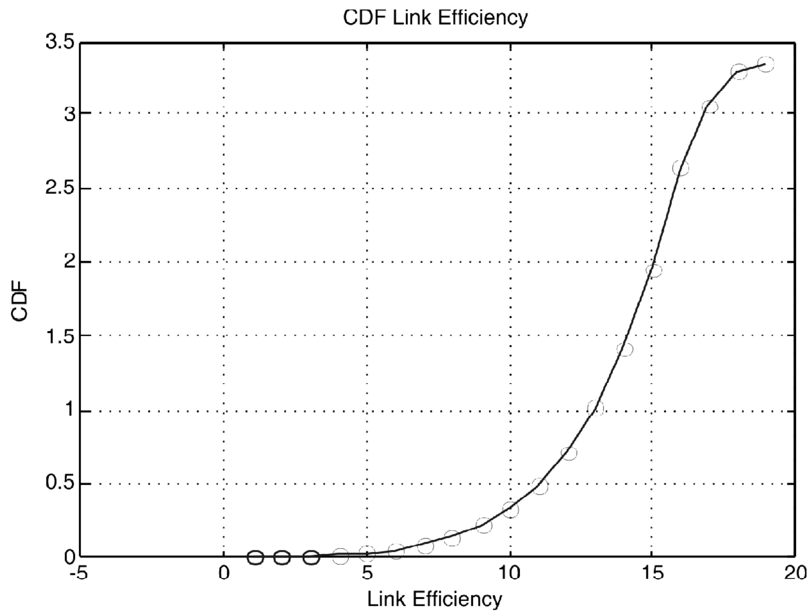

Figure 7: SNR Vs Outage Probability

Figure 7 represents the link efficiency of all the users.

5. CONCLUSION

In this paper the power allocation for each user is analyzed depending upon their SNR values and the input (1dB) power is efficiently utilized by all users, and also BER is reduced by the AAF and DAF techniques. The proposed technique uses two algorithms; namely OOBS and SBS in AAF and DAF techniques. The algorithms are used efficiently to allocate the input power to each user's SNR value and to provide high power utilization with low bit error rate.

REFERENCES

[1] L. Fu, Y. J. A. Zhang, and J. Huang, "Energy efficient transmissions in MIMO cognitive radio networks," *IEEE J. Sel. Areas Commun.*, vol. 31, no. 11, pp. 2420–2431, 2013.

[2] W. Bocquet, "A Power Allocation Scheme for MIMO OFDM Systems," vol. 0022, no. 1, pp. 8–11.

[3] J. Shu and W. Guo, "Efficient Bandwidth and Power Allocation Algorithms for Multiuser MIMO-OFDM Systems *," vol. 2009, no. September, pp. 504–510, 2009.

[4] Y. Zou, X. Wang, and W. Shen, "Optimal relay selection for physical-layer security in cooperative wireless networks," *IEEE J. Sel. Areas Commun.*, vol. 31, no. 10, pp. 2099–2111, 2013.

[5] V. K. Shah and A. P. Gharge, "A Review on Relay Selection Techniques in Cooperative Communication," vol. 2, no. 5, pp. 65–69, 2012.

[6] A. I. Akin and H. Ilhan, "Relay Selection for Af Based Cooperative Networks," vol. 19, no. 19, pp. 26–29, 2015.

[7] P. Cheng, R. Deng, and J. Chen, "Energy-efficient cooperative spectrum sensing in sensor-aided cognitive radio networks," *IEEE Wirel. Commun.*, vol. 19, no. 6, pp. 100–105, 2012.

[8] G. Levin and S. Loyka, "Amplify-and-Forward Versus Decode-and-Forward Relaying/ : Which is Better/ ?," pp. 123–126, 2012.

[9] P. Zhang, J. Yuan, J. Chen, J. Wang, and J. Yang, "Analyzing Amplify-and-Forward and Decode-and-Forward Cooperative Strategies in Wyner ' s Channel Model."