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Co-Operative Communication in Dean forming Analysing for MIMO System using Multiple Relay Path Channels

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Abstract:- **In Cooperative Communication (Co-Operative MIMO)We are having Multiple users Here we consider a transmit multiple relay path design for multiple-input–multiple-output (MIMO) decode-and-forward (DF) half-duplex two-hop relay channels with a direct source–destination link. This paper present beam forming technology in Cooperative MIMO Cognitive Radio Networks. The amplify-forward and half-duplex mode is used in the relay transport protocol in MIMO Cognitive Radio Networks. A novel algorithm of singular value decomposition and least-mean-square error (SVD-MMSE) beam forming is proposed. The transmitting information using low-density parity-check code (LDPC) can effectively use spatial diversity to improve system performance. Through MATLAB simulations shows that the hybrid algorithm SVD-MMSE bit-error rate performance can improve 0.5dB and 0.4dB at BER = 10^6 than only SVD algorithm and MMSE algorithm, respectively. . In this condition, the probability of detection increases, which in turn reduces the bit error rate (BER). Employment of a number of relay nodes reduces the sensing time and increases the throughput(capacity) of the system.**

Keywords:- **Cooperative Communication ,MIMO,AF & DF, Cognitive Radio Networks, SVD,LS & MMSE, LDPC, BER &Capacity.**

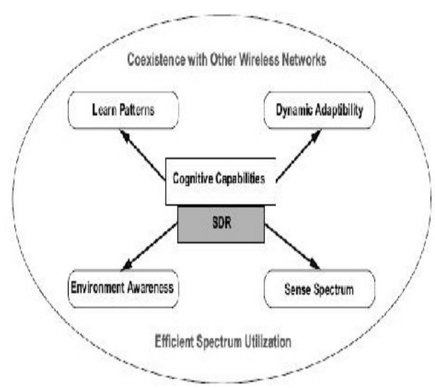
1. INTRODUCTION

Cognitive radio has emerged as a promising technology for maximizing the utilization of the limited radio bandwidth while accommodating the increasing amount of services and applications in wireless networks[2]. A cognitive radio (CR) transceiver is able to adapt to the dynamic radio environment and the network parameters to maximize the utilization of the limited radio resources while providing flexibility in wireless access. The key features of a CR transceiver are awareness of the radio environment (in terms of spectrum usage, power spectral density of transmitted /received signals, wireless protocol signaling) and intelligence. This intelligence is achieved through learning for adaptive tuning of system parameters such as transmit power, carrier frequency, and modulation strategy (at the physical layer), and higher-layer protocol parameters. Development of cognitive radio technology has to deal with technical and practical considerations (which are highly multidisciplinary) as well as regulatory requirements[1].

COGNITIVE radio (CR), built on software-defined radio, has been proposed as a means to improve the utilization of wireless spectrum resources. Spectrum sensing is a core technology upon which the entire operation of cognitive radio rests. It enables unlicensed users (also referred to as secondary users or cognitive users) to communicate with each other over licensed bands by detecting spectrum holes.

2. OFDM FOR COGNITIVE RADIO

OFDM stands for Orthogonal Frequency Division Multiplexing. It is the multi-carrier modulation technique in which data is split up into chunks and every chunk are modulated using closely spaced orthogonal subcarriers. The orthogonal subcarriers have the property that they do not have any mutual interference between them. So, this scheme is very useful for high bit-rate data communication. One of the serious problems of high data rate transmission is time dispersion of pulses resulting inInter-symbol Interference (ISI). In OFDM, the data is split into several low-rate data chunks and are modulated in overlapping orthogonal subcarriers. These splitting increases the symbol duration by the number of subcarriers used, thus reducing the ISI due to multipath[4].



OFDM is adapted as the best transmission scheme for Cognitive Radio systems. The features and the ability of the OFDM system makes it fit for the CR based transmission system. OFDM provides spectral efficiency, which is most required for CR system. This is because the subcarriers are very closely spaced and are overlapping, with no interference. Another advantage of OFDM is that it is very flexible and adaptive. The subcarriers can be turned on and off according to the environment and can assist CR system dynamically. OFDM can be easily implemented using the Fast Fourier Transform (FFT), which can be done by digital signal processing using software. The performance of this transceiver is verified by analysis and computer simulation. This scheme is then incorporated into the cooperation strategy of to investigate its performance under realistic conditions. It is revealed that although the performance of the cooperative network is degraded due to the residual interference imposed on the receiving subcarriers by the transmitting subcarriers, it still performs better compared with conventional cooperation schemes.

3. BEAM FORMING ANALYSIS

Beam forming design for the three-node MIMO DF relay network with source-destination direct link. We assume that both the source and relay nodes are equipped with multiple antennas while the destination node is only deployed with single antenna. Such a transmission scenario is readily applicable to the downlink transmission of a relay-enhanced cellular system where the base-station and the relay can accommodate multiple antennas but the mobile user equipment can only afford a single antenna due to size or other constraints. Note that downlink transmission to resource-limited mobile terminals limits the overall performance of cellular systems.

The special diversity advantage of MIMO DF relay channel to enhance system throughput to the destination node. Unlike complex numerical solutions, we strive to derive the explicit expressions for the optimal beam forming design for our concerned model. Specifically, we identify several unique properties of the optimal solutions through mathematical derivation, based on which we develop a systematic approach to arrive at the optimal beam forming vectors for the source and relay nodes for different system configurations. We would like to stress that deriving the explicit expressions of the optimal beam forming design for our concerned model with single-antenna destination node is by no means trivial. This is because the MIMO channel between the source and the relay nodes and the multiple-input multiple-output (MISO) channel between the source and the destination nodes have to be jointly considered and balanced. In addition, our explicit solutions, which cannot be otherwise obtained as the special cases of previous work, offer interesting new insight to the design of MIMO DF beam forming[8].

4. MIMO-OFDM SYSTEM MODEL

In high-speed wireless communication, combining MIMO and OFDM technology, ofdm can be applied to transform frequency-selective MIMO channel into parallel flat MIMO channel, reducing the complexity of the receiver, through multipath fading environment can also achieve high data rate robust transmission. Therefore, mimo-ofdm systems obtain diversity gain and coding gain by space-time coding, at the same time, the ofdm system can be realized with simple structure. Therefore, mimo-ofdm system has become a welcome proposal for 4g mobile communication systems. The basic structure of mimoofdm system model l is shown in figure 1.

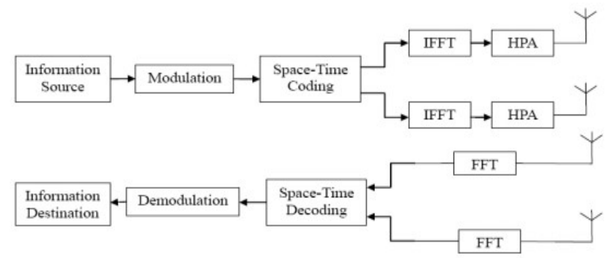
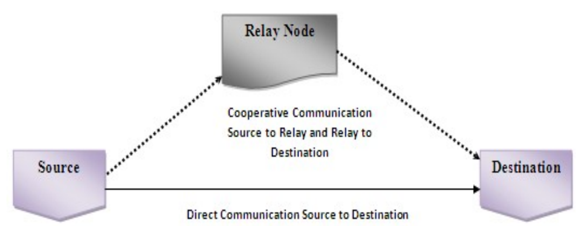


figure 1. Basic structure of MIMO OFDM system

At the transmitting end, a number of transmission antennas are used. An input data bit stream is supplied into space time coding, then modulated by ofdm and finally fed to antennas for sending out (radiation). At the receiving end, incoming signals are fed into a signal detector and processed before recovery of the original signal is made.

5. COOPERATIVE COMMUNICATION

Wireless communication which is most functional in terms of mobile access is currently a highly demanded communication technology. It has gone through several developmental phases since its inception so that it can meet to the ever changing needs of its wide range of applications. The biggest challenges in the history of wireless communications which has induced considerable research for possible solutions are the multipath fading, shadowing and path loss effects of wireless channel[7].



Random variations of channel quality in time, frequency and space are caused by these effects. The method that involves the use of a single all purpose device to deploy network services results in design complications which result in inefficient use of battery power causing short battery life. Users can ease off the load on the network and in turn increase the capacity and battery life for their devices by cooperative communications in such situations[10].

This technique which was based on the analysis of the capacity of a three- node network consisting of a source, a relay and a receiver has the assumption that all nodes operate in the same band. Therefore the system could be decomposed into a broadcast channel with respect to the source and a multipath access channel with respect to the destination. The

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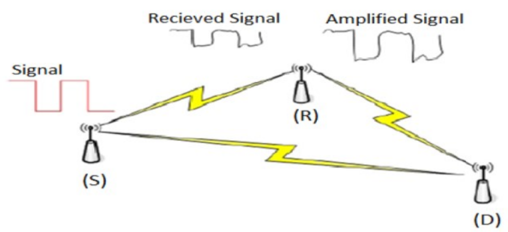
relays whole and sole purpose is to help main channel, in the work on the relay channel but in cooperative communication[11],[12], he total system resources are fixed, and users act both as information sources and as relays. In spite of indisputability of the historical importance of the first work on relay channel, recent work in cooperation has taken a somewhat different emphasis. To enable cooperation among users, different relaying techniques could be employed depending on the relative user location, channel conditions, and transceiver complexity. These are methods that define how data is processed at the relays before onward transmission to the destination. There are different types of cooperative communication strategies which would be outlined. These include the Amplify and Forward (AAF) and Decode and Forward

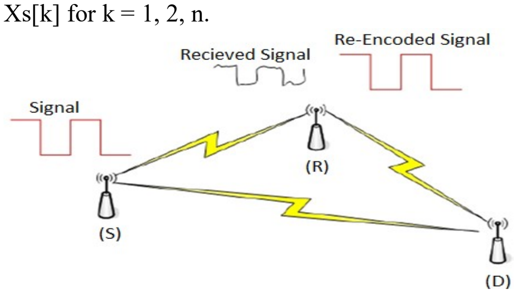
5.1. Amplify-and-forward strategy (AAF)

This is a simple cooperative signalling method where each user receives a noisy version of the signal transmitted by its partner amplifies it and retransmits to the base station. The base receives two independently faded versions of the signal and combines them in order to make better decisions on information detection[5],[9].



5.2. Decode-and-forward strategy (DAF)

This strategy follows that the relay station decodes the received signal from the source node, re-encodes it and forwards it to the destination station. It is the most often preferred method to process data in the relay since there is no amplified noise in the signal sent. Again, consider the case of a single relay. The simplest algorithm described below again divides transmissions into two blocks of equal duration, one block for the source transmission and one block for the relay transmission. For the simplest algorithm, the source transmits Xs[k] for k = 1, 2, n.



AF and DF aforementioned are often called fixed cooperation modes because the relay node always participates in cooperative communication no matter what the channel transmission characteristics are. As a matter of fact, cooperation does not always bring benefits. For example, in a half duplex mode, the data transmission rate and the utilization of the degrees of freedom will decrease. This indicates when to cooperate is a critical issue[5],[9].

Tabulation: Comparison between AF and DF Relay Path Analysis on MIMO-Cooperative Communication

Forward Mode	**Fixed Mode**	**Selection Mode**	**Incremental Mode**
AF (Amplify Forward)	Fixed AF	Selection AF	Incremental AF
DF (Decode and Forward)	Fixed DF	Selection DF	Incremental DF

Selection modes compare transmission characteristics of the source-relay channel against a predefined threshold. Only when the characteristic value is greater than the threshold, cooperative communication is implemented; otherwise, the source node direct transmission again. Hence, the key in selection modes is the conditions of source-relay channel. In incremental modes, the feedback of the destination node is used to determine whether the direct transmission is successful. If the data are correctly detected, source node will send new data; otherwise, the relay node will participate in the cooperative communication process. This process is equivalent to adding redundancy mechanism or automatic detection and retransmission mechanism in the relay transmission[6].

From the perspectives of reliability and effectiveness, Incremental AF (IAF) performs best. In terms of the complexity of algorithm, AF is simplest and can achieve full diversity gain; DF performs poor and cannot obtain full diversity gain; Selection DF (SDF) can achieve full diversity gain but it is more complicated than AF. Analyses show that both Selection AF (SAF) and Incremental DF (IDF) cannot achieve good performance: Selective mode pays much attention to the transmission characteristics of the source-relay channel, but in AF, the source-relay channel and the relay-destination channel are of the same importance because the relay node only amplifies, not decodes, the information received from the source node; the incremental mode focuses on the source-destination channel, but in DF scheme, errors will accumulate and broadcast with information forwarding if serious fading takes place on the source-relay channel and lots of errors are resulted from decoding. Therefore, selection mode is more suitable for DF scheme, while incremental mode is more suitable for AF scheme.

6. RESULT ANALYSIS

In fact, users of a wireless network can cooperate by relaying each other’s messages thus improving the communications reliability. However, the limited communication resources, such as battery lifetime of the devices and the scarce bandwidth, challenge the design of such cooperative communication schemes. The communication system of a conventional multi-node decode-and-forward cooperative scheme is shown in Fig.

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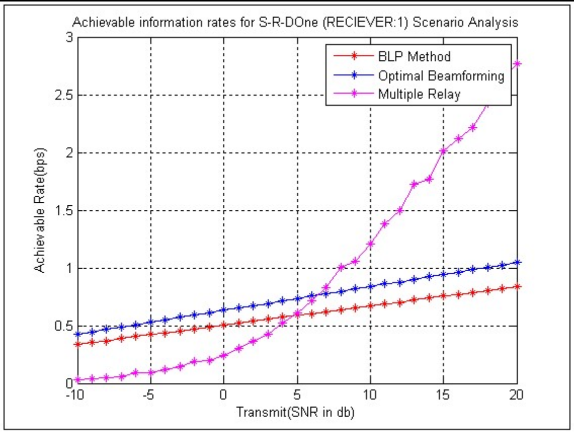

Fig.2:-Comparison of the achievable transmission rates of our proposed schemes with the BLP ,Optimal and the Multiple Relay method for the Ns:Nr:Nd scenario.

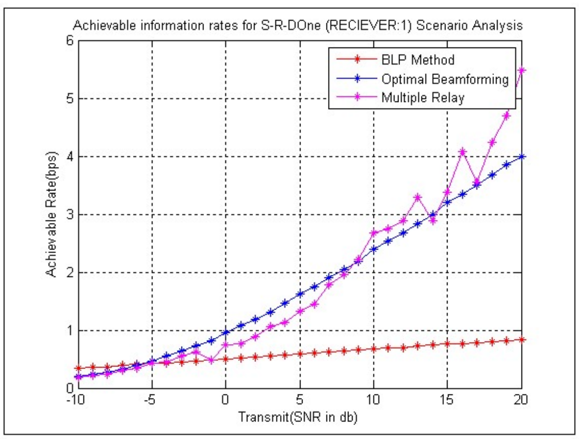

Fig.3:-Comparison of the achievable transmission rates of our proposed schemes with the BLP ,Optimal and the Multiple Relay methodfor the Ns:Nr:Nd scenario.

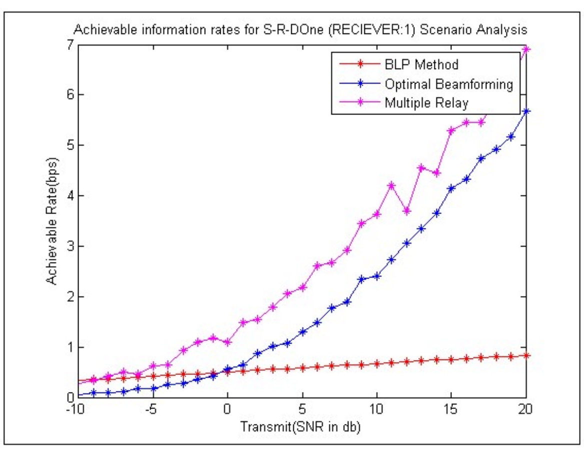

Fig.4:-Comparison of the achievable transmission rates of our proposed schemes with the BLP ,Optimal and the Multiple Relay method for the Ns:Nr:Nd scenario.

7. OPTIMAL BEAM FORMING DESIGN NS:NR:ND SCENARIO

We now consider another special case where **Ns** antennas are deployed at the source and a multiple antenna is employed at atboth the relay node and the destination, i.e., ***Ns:Nr:Nd***scenario.The conventional multi-node decode-and-forward scheme is implemented in N + 1 time slots (phases) as follows. In the first phase, the source broadcasts its data, which is received by the destination as well as the N relays. The first relay decodes what it has received from the source and checks if it has received the data correctly. If it has received the data correctly, it re-encodes the data to be broadcasted in the second phase. Otherwise, it remains idle. Generally in the i-th phase, the (i − 1)-th relay combines the signals coming from all the previous relays and the source, re-transmits the data if it has decoded correctly, and remains idle otherwise.

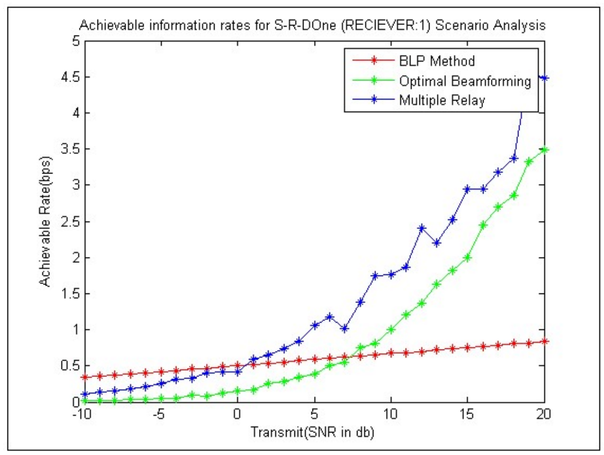

Fig.5:-Comparison of the achievable transmission rates of our proposed schemes with the BLP ,Optimal and the Multiple Relay method for the Ns:Nr:Nd scenario.

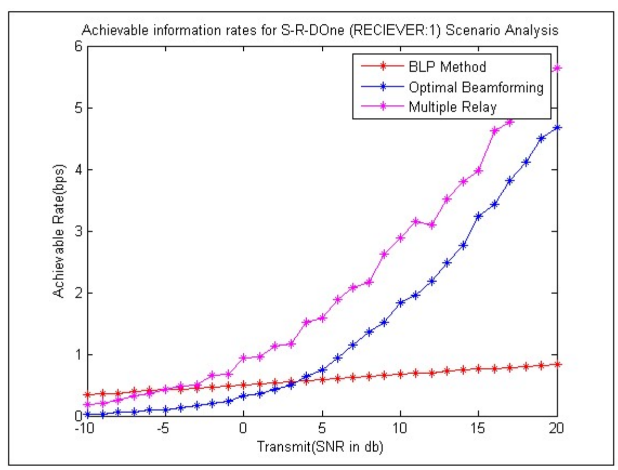

Fig.6:-Comparison of the achievable transmission rates of our proposed schemes with the BLP ,Optimal and the Multiple Relay method for the Ns:Nr:Nd scenario.

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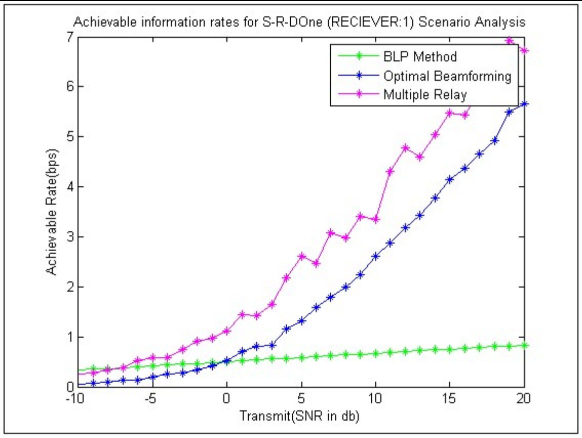

Fig.7:-Comparison of the achievable transmission rates of our proposed schemes with the BLP ,Optimal and the Multiple Relay method for the Ns:Nr:Nd scenario.

CONCLUSION

In this paper, the performance of cooperative relaying is investigated. It is found that multiple number of cognitive relay nodes improve spectrum sensing performance. It is shown that the optimal sensing time of CR reduces with the increasing number of relay nodes. we studied the problem of distributed beam forming in a network which consists of a transmitter, a receiver and relay nodes. Assuming, we designed the beam former through minimization of the total transmit power subject to a constraint which guarantees the receiver quality of service. Next, we obtained the beam forming weights through maximizing the receiver SNR subject to two different types of power constraints, namely total transmit power constraint and individual relay power constraints. It is shown that the optimal sensing time of CR reduces with the increasing number of relay nodes. Reduction in optimal sensing time results in increase of the optimal throughput of the CR significantly. We herein have shown that the total power constraint leads to a closed-form solution while the individual relay power constraints result in a quadratic programming optimization problem. The later optimization problem does not have a decode and forward relay solution. Our simplified algorithm provides the beam forming comparison between transmit antenna and relay path destination of achievable rate increases. The above study is useful in designing relay based CR network.

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