Efficient Cooperative Spectrum Sharing MIMO Wireless Relay System with Filtering

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Abstract – The optimality of the spectrum sharing network is highly sensitive to the fading effects of the wireless channels which call to integrate the relays to the system to reduce the power losses of the system. Use of relays makes system cooperative in nature and such will be called cooperative spectrum sensing networks, and with the application of relays the losses will be decrease. Here Nakagami fading model is taken into consideration for best real life wireless scenarios. This analysis has been proved by many researchers, So here, the same concept has been integrated with the MIMO system followed by 1-D digital filtering make system more optimal in terms of outage. Simulation outcomes clearly show the optimality of the approach shown in this work.

Keywords: MIMO, Cooperative Systems, Hybrid Multi-Relay, Outage probability, Spectrum Sensing, Nakagami Fading.

I. INTRODUCTION

The Internet facilitates communications worldwide with communication networks extensively developed. Especially, wireless technology applied in communication networks is and will still be the pervasive access strategies nowadays and in the future. Wireless communications enable the emergence of many rising up-to-date concepts, such as smart city, and Internet of Things (IoT), etc., which constitute the future mobile networks.

Evidently, not only the human-to-human communication, but also more complex communication modes including device-to-device, machine-to-machine communications and the interaction of these communications are expected to play indispensable role in the future mobile networks. As in Figure 1.1, future mobile networks enable to serve a much broader range of use cases, leading to high connectivity of individuals and communities.

It is the inter-networking of objects of the physical world (physical things) or the information world (virtual things) which enables advanced services based on existing and evolving interoperable information and communication technologies. To offer advanced connectivity of devices, systems, and services, meanwhile to support consumer demand for data grows, hierarchicalnetwork infrastructure and intelligent use of resources are required. While future mobile networks have many anticipated advances, challenges are also incurred to conventional wireless networks.

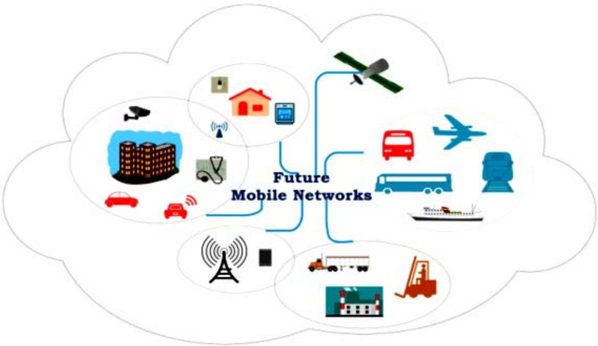

Fig. 1.1 Architecture for future mobile communication network.

Wireless signals will be received by every potential user in communications as a consequence of the broadcast nature. In that case, multiple users with diverse communication requests and objectives are involved. Within limited spectrum re- sources, supporting the increasing data traffic from different users and services still poses significant challenges. Therefore, some key technologies are essential in wireless systems, such as the proper management of users, the efficient schemes for transmission reliability and the intelligent strategies for resource utilization.

For example, in a dense network, users from different systems coexisting in the same. Area may need to share the same resource; to extend the coverage of services, the multi-hop transmission may be employed; to improve resource utilization, the spatial reuse of the spectrum is unavoidable. As a result, these new features and trends of wireless networks bring us more requirements on performance modeling and analysis, as well as more demands for designing and developing new solutions to improve spectrum efficiency. To this end, a promising direction towards achieving efficient communications in wireless networks is studied in this examination work, named smart cooperation in hierarchical wireless networks.

In this examination work, a basic view of the system with a limited number of terminals is considered, which a MATLAB based model providing simulation based verification is. This system model is capable of capturing important characteristics and features of wireless networks, and can therefore be served as a building block and provide a basis for better understanding of more general.

II. RELAYING STRATEGIES MODEL

The study of cooperative MIMO relaying networks is the main objective of this examination work to implement a new model, but it is not a single network study. Indeed, it is a comparison between its performance in terms of throughput and the performance of the multihop network and the traditional infrastructure network.

The increasing number of users and the existence of more resource demanding services require a higher link data rate than the one that can be achieved in current infrastructure networks.

This relay network uses all the relays to retransmit the signal transmitted by the BS (downlink case). In the first case, the signal will only be received from the relays, and in the second case the direct path (signal arriving directly from the BS) will also be considered.

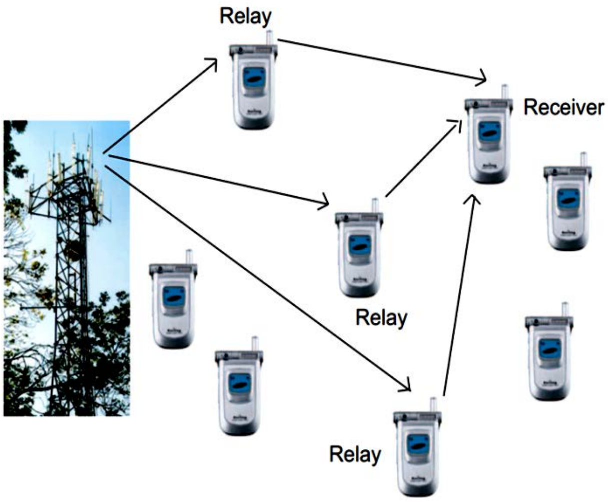

Fig.2.1 Example of cooperative MIMO relaying network.

By using the concept are emulating a MIMO system, and in order to get the highest capacity the number of transmit and receive antennas will be the same. In the case of more transmitted antennas, the system capacity saturates very quickly, provided that high SNR. On the other hand, if there are more receive antennas, the capacity will increase in a logarithmic fashion, having a low improvement as increase the number of receive antennas compared to the difficulties and cost of the extra antennas. Regarding this result will use as many transmit antennas as receive antennas. Thus, if consider the direct path it will have as receive antennas the antennas from the RSs plus the receiver antenna. From now on it will follow the relation: Number of BS antennas = Number of RSs + 1.

To avoid interference among the transmitters (RSs and BS) it will divide the total bandwidth in channels. There will be as many channels as transmitters, meaning that if N RSs, used the total bandwidth for each transmission will be divided by N + 1.

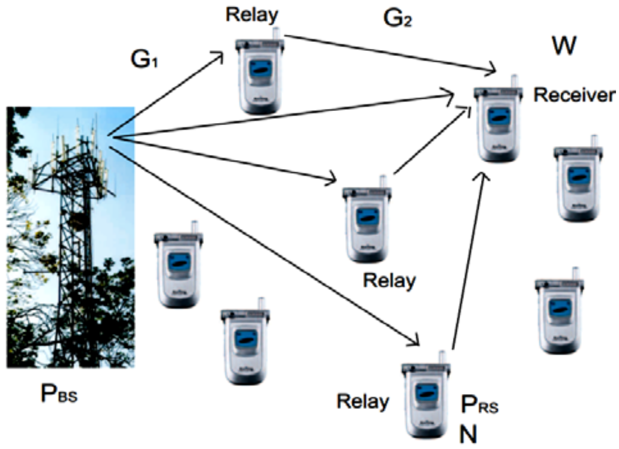

Fig.2.2 Example of cooperative MIMO relaying network with direct path.

How to realistically model transmit power constraints is definitely a controversial topic. The most common assumption in the MIMO examination work is a sum-power constraint over all the transmit antennas, as opposed to a per-antenna power constraint.

III. PROPOSED METHODOLOGY

This work presents an Efficient Cooperative Spectrum Sharing MIMO Wireless Relay System.Cooperation among users enables the use of spectrum sharing to achieve a more efficient resource usage. In cognitive radio networks, based on the resource features and user priorities, spectrum resources can be shared among equal primary users or between primary and secondary users. The implementation and simulation of proposed model has been completed in MATLAB.

A cognitive radio network has been established with cooperative transmission by the secondary transmitter, where the advantage of network coding is accomplished by combining the relaying to the primary receiver with the transmission to the secondary receiver. The bock representation of proposed work has been shown in Fig. 3.1. As shown in Fig. there are three fundamental block are illustrated. The signal preprocessing block prepare signal for transmission. Tx stand for transmitter in Fig. and Rx stands for receiver in Fig. R inside a circle represents relay. The simple concept of MIMO wireless along with relay communication also known as cooperative communication has been used in this work. The operation is very simple, preprocessing signal block handover signal to Tx to arrive signal to receiver relay will be worked as a intermediate. Relay will receive and retransmit signal to reviewer. Receiver hands over received signal to second order filtering block and after Appling filtering actual information can be retrieved.

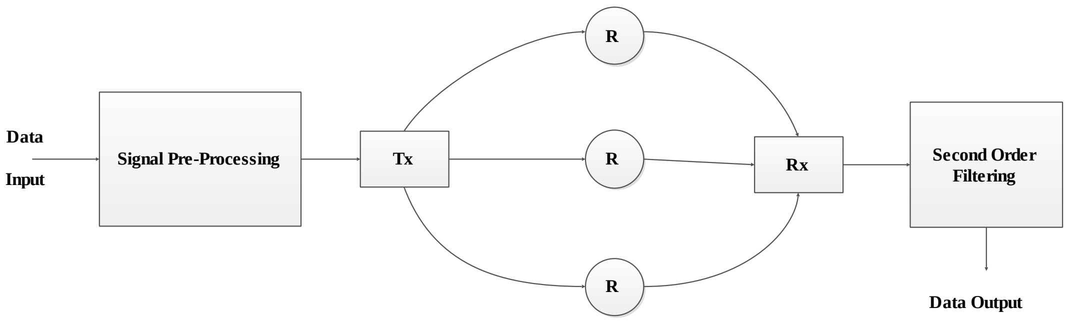

Fig. 3.1 Block Diagram of Proposed Model.

In cooperative communications when there are multiple secondary users capable of helping while looking for opportunities the best relay selection algorithm provides flexibility and diversity. Clearly, jointly considering the quality of the two links related to the relay leads to a possibly larger fraction of spectrum resources that the secondary system can access.

Beamforming is a technology used to alleviate the inflicted interference in spectrum-sharing systems. It enables simultaneous transmission. However, beamforming needs multiple antennas to be deployed by the unit to be realized.Cooperative relaying rose as a powerful answer for enhancing the execution of single-antenna and multiple antenna communication nodes. This is accomplished by making utilization of intermediate relay nodes, which are utilized to help transmission from the source to the goal. Two basic relaying protocols are introduced where the relay decides either to amplify-and-forward (AF) or decode-and-forward (DF) according to the received signal-to-noise ratio (SNR). Cooperative relaying schemes are adopted in spectrum-sharing systems in order to increase the capacity, the reliability and the coverage of the secondary system.

The proposed work is important in various ways. It certainly addresses a timely topic (Cooperative MIMO relay network system), which is expected to play a major role in many of the future wireless communication systems. this innovation is relied upon to reform how wireless communication networks will be actualized or deployed later on, with an addressing the issue of spectrum under-utilization.

The Combination of distributed beamforming and cooperative relayingis by all accounts a decent arrangement in spectrum-sharing systems.In any case, such systems have basic difficulties that must be addressed so as to get the benefits from this combination. The flow chart of the implementation of proposed work has shown in Fig. 3.2 implemented in MATLAB network simulation environment a Nakagami fading channel is used in order to model interference from multiple sources in a cellular system.

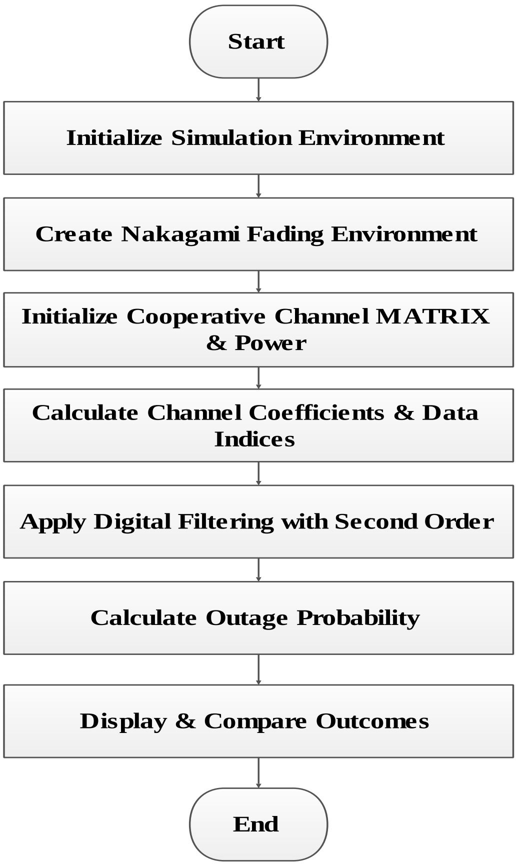

Fig. 3.2 Flow chart of proposed work.

IV. SIMULATION RESULTS

To alleviate the deleterious effect of fading, one may use transmit diversity, which is achieved by deploying multiple antennas at the transmitter. However, this is not always possible in many wireless devices due to the size and/or power limitations. In cooperative networks, wireless nodes are assumed to transmit their own data while acting as cooperative agents (relays) for other nodes, which is a win-win situation because this improves the overall performance.

Recently, cooperative relaying schemes have been adopted in spectrum-sharing systems where the inflicted interference is limited by only controlling the transmit power of the secondary transmitters. Both DF and AF schemes are employed in order to increase the reliability and the coverage of the secondary systems. Also, different selection methods are applied such as opportunistic and partial relay selection.

In traditional systems, outage occurs when the received SNR at the destination falls below a pre-determined threshold. However, in spectrum-sharing systems, besides the previous reason, outage occurs when the interference constraint imposed on the secondary transmitters (to limit the inflicted interference on primary users) is not satisfied.

A comprehensive outage analysis is carry out in proposed work based on MATLAB simulationfor a secondary system operating under strict primary system outage constraintsin a spectrum-sharing underlay environment using Nakagami fading channel.

Proposed work focus on multiple antennawith efficient cooperative spectrum sharingrelay communication.Nakagami fading channel is used to actualize real-time environmental scenario. Two transmit power scenariosare proposedfor the system based on complete or partial knowledge of channel. Using MATLAB simulation derived thecumulative distribution functions (CDF) of the received SNR (signal-to-noise ratio).

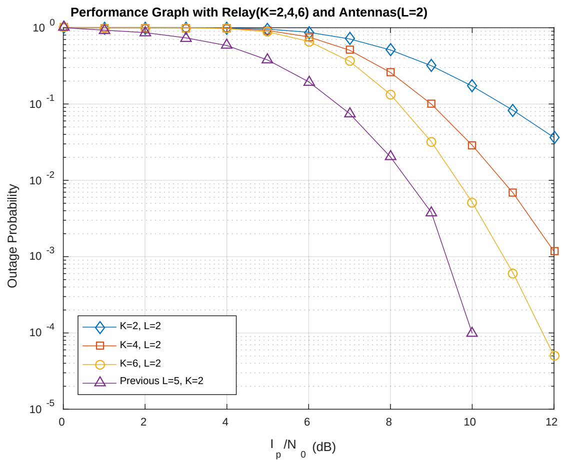

Fig. 4.1 Outage Probability of Cooperative Network with Spatial Diversity and K=2,4,6 Relays and L=2 Antennas.

These measurements are then used to determine the correct end to end outage probability. At last, the diagnostic and simulation results are examined and curiously appeared with flawlessly coordinate, while uncovering that with a moderate number of primary and secondary receive antennas. Fig. 4.1 shows the MATLAB scope waveform of Outage Probability of Cooperative Network with Spatial Diversity and K=2,4,6 Relays and L=2 Antennas. Fig. 4.2 Outage Probability of Cooperative Network with Spatial Diversity and K=2,4,6 Relays and L=4 Antennas. Fig. 4.3 Outage Probability of Cooperative Network with Spatial Diversity and K=2,4,6 Relays and L=6 Antennas

From Fig. 4.1 Relays (k=2) and antennas (L=2), Relays (k=4) and antennas (L=2), Relays (k=6) and antennas (L=2) are the following configurations are used and in previous work Relays (k=2) and antennas (L=5) are used the outage probability is shown in vertical or y-axis from the observation it is clear that proposed work has better performance as compared to previous work.

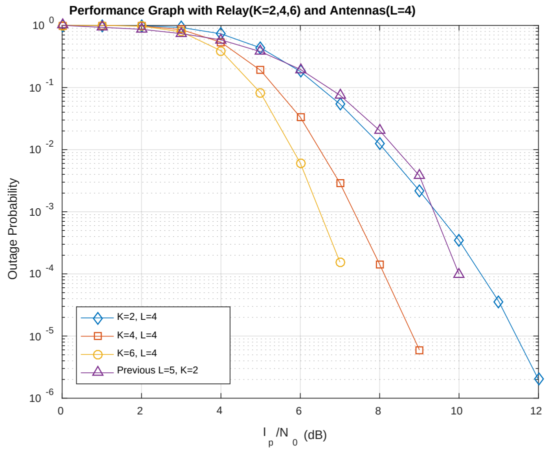

Fig. 4.2 Outage Probability of Cooperative Network with Spatial Diversity and K=2,4,6 Relays and L=4 Antennas.

From Fig. 4.2the same system has been verified for different antennas and relay configuration Relays (k=2) and antennas (L=4), Relays (k=4) and antennas (L=4), Relays (k=6) and antennas (L=6) are the following configurations are used and in previous work Relays (k=2) and antennas (L=5) are used the outage probability is shown in vertical or y-axis from the observation it is clear that proposed work has better performance as compared to previous work.

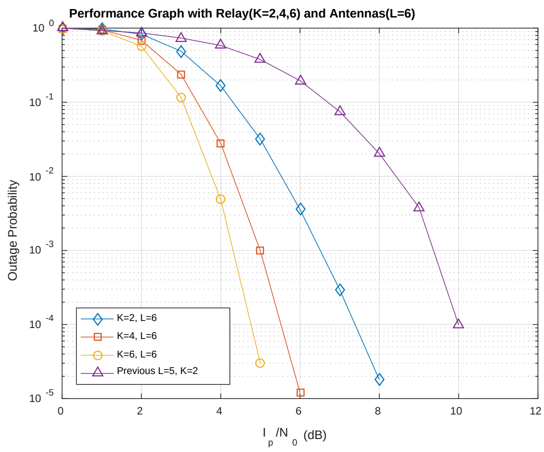

Fig. 4.3 Outage Probability of Cooperative Network with Spatial Diversity and K=2,4,6 Relays and L=6 Antennas.

From Fig. 4.3 the proposed has been verified for different antennas and relay configuration Relays (k=2) and antennas (L=6), Relays (k=4) and antennas (L=6), Relays (k=6) and antennas (L=6) are the following configurations are used and in previous work Relays (k=2) and antennas

(L=5) are used the outage probability is from the observation it is clear that proposed work has better performance as compared to previous work

V. CONCLUSIONAND FUTURE SCOPE

In this work an efficient cooperative spectrum sharing MIMO wireless relay system has been proposed. The proposed system has implemented in MATLAB and performance of proposed system is examined based on outage probability.To verify the performance a comparative analysis of proposed work with existing work has been carried out. Cognitive radio techniques have been intensively studied to improve the utilization efficiency of the scarce spectrum so as to accommodate the increasing wireless data transmission requirements. In this context, cooperative techniques have been adopted as an effective way to facilitate the spectrum sharing, as the space diversity can be achieved. However, the overlay spectrum sharing based on the traditional cooperative protocols is proved to be inefficient, as multiple communication phases are usually included to transmit the same signal. This examination aims to propose a variety of relay based spectrum sharing designs, time, and frequency domains to significantly improve the bandwidth efficiency of the modern relay based cooperative communication system. Due to the time limitations of work many things have been left for possible posterior studies. One of these things would be to extend the actual work into a multi-cellular system. In proposed future work another channel model would be supposed to use.The future work will be focus onthe observation of the influence of other elements and the interference that they introduce.

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