A Comparative Study on Cooperative Spectrum Sharing with Adaptive Relays

Priyanka Patel[1], Prof. Swatantra Tiwari[2]

[1]M.Tech. Scholar, [2]Guide

Department of Electronics and Communication Engineering, RIT, Rewa

Abstract - Cooperative communication has turned out to be one of the prevalent research themes as the answer for the battery life issue and expanding the transmission capacity and performance. The cooperative communication plan and framework description are planned in detail. The essential guideline of cooperative communication is utilizing other communication gadgets to relay transmission. the source node communicates data to both the relay node and the goal node. The relay node then forwards the transmission to the goal hub. The source hub views the relay hub as a virtual radio wire, empowering Half breed Relay frameworks to be utilized without adding physical reception apparatus. Since the source nodes in the cooperative communication plot relies upon the relay hubs to forward the transmission, relay determination and asset designation for the relay nodes end up imperative keeping in mind the end goal to acquire ideal performance of the cooperative communication framework. By picking the correct nodes to relay the transmission, the framework can accomplish higher capacity by utilizing lower assets.

Keywords-Relay Selection, hybrid decode amplify forward (HDAF),Adaptive Relay,best relay selection.

I. INTRODUCTION

In this unit, a simple cooperative wireless network with helper in the presence of single eavesdropper is shown in the Fig1.1. Total communication process occurs in two stages. First phase is called broadcasting stage, in which source broadcasts its information to legitimate receiver with power Ps, but because of broadcast nature of transmission medium relay and eavesdropper overhears the source information.

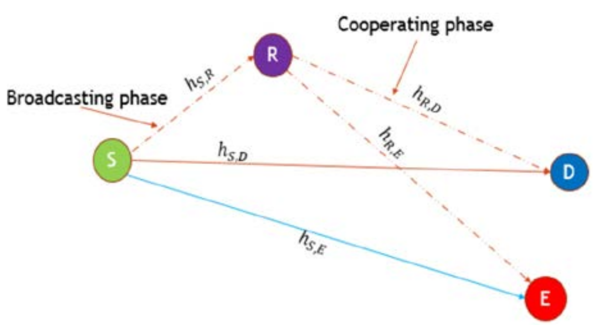

Figure 1.1 Simplified Cooperative Model.

After receiving the information signal from the source, relay uses cooperating relaying schemes to process the signal. Elemental cooperating relaying schemes to transmit the information signal to the destination are Decode and Forward (DF) and Amplify and Forward (AF). In addition to these two relaying schemes, Cooperative jamming is used by the relay, to produce artificial interference to confound the eavesdropper .To combine the benefits of both DF and AF, a new cooperating relaying scheme Hybrid Decode-Amplify-Forward (HDAF) is introduced in this section.

In DF relaying, source broadcasts information that is decoded by destination and relay. The relay re-encodes the data and broadcasts this data to the destination. Thus due to the regeneration of the source's information at the relay node, the error propagation from the source-relay node is minimized to the destination. But this also leads to the increase in complexity of the relay node. In decode and Forward (DF) relaying scheme, relay first decodes the received source signal, then re-encode it and forwards to the destination. When the signal to noise ratio of the received source signal exceeds a certain threshold value, relay can perfectly decode the signal. Arrived signals at the destination and eavesdropper are given as,

$$Y_{r,d} = \sqrt{P_r} H^*_{r,d} S_{DF} + n_d$$

$$Y_{r,e} = \sqrt{P_r} H^*_{r,e} S_{DF} + n_e$$

Here Pr is the power transmitted by the relay node, Hrd is the rayleigh channel fading coefficient of helper-destination link, Hr e is the rayleigh channel fading coefficient of helper-eavesdropper link, SDF is the processed information signal using decode and Forward (DF) cooperative relaying scheme and nd,ne are the AWGN noises with zero mean and variance 1 at destination and eavesdropper respectively.

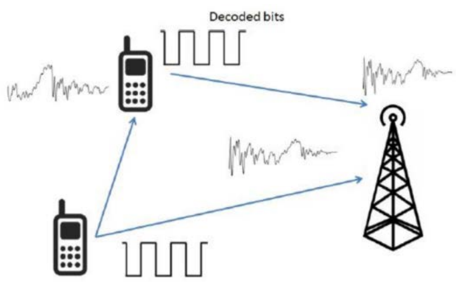

Figure 1.2 Decode and Forward (DF) Relating Scheme

In Amplify and Forward (AF) relaying protocol, relay first amplifies the received information signal and then forwards to the destination. But the disadvantage with AF relaying is, it also amplifies the noise signal along with the information signal. Arrived signals at the destination and eavesdropper are given as:

$$Y_{r,d} = \sqrt{P_r} H_{r,d}^{*} S_{AF} + n_d$$

$$Y_{r,e} = \sqrt{P_r} H_{r,e}^{*} S_{AF} + n_e$$

Pr is the power transmitted by the relay node, Hr d is the rayleigh channel fading coefficient of helper-destination link, Hr e is the rayleigh channel fading coefficient of helper-eavesdropper, SDF is the re-encoded signal at the best relay and nd, ne are the AWGN noises with zero mean and variance as 1 at destination and eavesdropper respectively.

► Cognitive cooperative Relay network

An extensive study on three traditional relay protocols, i.e., fixed relaying, selection relaying, and incremental relaying has been conducted. Depending upon the method used by the relay to process and forward the received signal from the source to the destination, important protocols such as amplify-and-forward (AF), decode-and-forward (DF), and compress-and- forward (CF) can be implemented. In this work, author focus on the DF protocol. The DF protocol has an advantage over AF protocol in reducing the effects of channel interferences and additive noise at the relay. Its use over the AF protocol helps to avoid the noise amplification that happens with the AF protocol.

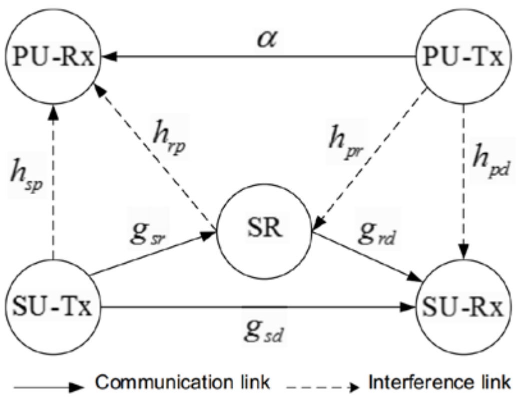

Figure 1.3Cognitive Cooperative Relay network.

► Best Relay Selection

This relaying scheme is the best to use when it comes to using minimal network resources. It requires only two channels for transmission. On the other hand, it shows that all the above schemes are using all the network channels in single transmission. The best relay is selected among the number of relays depending on the defined criteria which allows only two channels, i.e., between sender and relay and between relay to destination for communication. The relaying protocol can be AF or DF.

► Two-way Relaying Protocol

The spectral efficiency of the traditional one-way relaying is constrained due to the half duplex relaying. This loss in spectral efficiency can be mitigated with the help of two-way relaying where the two source nodes are allowed to communicate bi-directionally. Thus, improving the spectral efficiency in comparison to one-way relaying.

► Hybrid decode Amplify forward relaying (HDAF)

In decode and forward relaying, relay can decode the signal impeccably if it near is to the destination and when relay is far away from source, amplify and forward relaying can gives the better result compared to decode and forward. A new hybrid relaying scheme Hybrid Decode Amplify Forward (HDAF) is proposed in order to get the benefits of both DF and AF relaying schemes.

► Relay Selection

The aim of a relay selection procedure is to identify one relay node out of multiple candidates and assign it to a given source-destination pair. The overview here is limited to the selection of a single relay. Selection of multiple relays for virtual MIMO can be found e.g., in. Relay selection should provide efficiently a relay that optimizes required performance characteristics and, therefore, is critical for the performance of cooperative relaying. Most commonly this means a relay minimizing outage probability (in Bit Error Rate (BER) or Packet Error Rate (PER)) at the destination should be preferred.

► Adaptive Relaying

Selective relaying is one form of adaptive relaying. In the DF scenario, it is noted that the transmission reliability is limited not only by the relay-destination node link but also by the link between the source node and the relay node. Selective relaying takes advantage of the SNR information on the relay node to make decision whether to transmit to the destination or not. If the SNR of the received signal at the relay node falls below a certain threshold, the probability of correct decoding at the relay node will be lower, and it is better not to forward the transmission since it will have high probability to cause error in the destination node.

The concept of cooperative communications is to exploit the broadcast nature of wireless networks where the neigh bouring nodes overhear the source's signals and relay the information to the destination. As can be seen from Fig. 1, after receiving the signals resulting from the source, a third-party terminal acting as relays forwards their overhearing information to the destination so as to increase the capacity and/or improve reliability of the direct communication. The end-to-end transmission is clearly divided into two separate stages in the time domain: Broadcasting and relaying phase. In the broadcasting phase, i.e., broadcasting channel as seen from the source's viewpoint, all the receiving terminals including the relays and destination work in the same channel (time or frequency) as opposed to the second stage. In the relaying phase, i.e., multiple access channels as seen from the destination's viewpoint, the transmitting terminals (relay nodes) may operate in different channels to avoid co-channel interference.

II. LITERATURE SURVEY

Sr. No.	Title	Author	Year	approach
1	Cooperative spectrum sharing with multi antenna based Amplify-and-Forward and Decode-and-Forward Relay	A. Saha, C. K. De, A. Nandi and D. De	2016	a cooperative spectrum sharing with the help of a multi-antenna based cognitive relay (CR) employing best relay selection strategy is analyzed in presence of non-identical Rayleigh fading channel in this paper
2	Cooperative Spectrum Sharing with Energy-Save in Cognitive Radio Networks	Y. Li, Y. Li, B. Cao, M. Daneshmand and W. Zhang	2015	This paper proposes an energy-aware dynamic spectrum sharing framework, named Cooperative Spectrum Sharing with Energy-save(CSSE),
3	Use of in-and-quadrature phase signals for cooperative spectrum sharing	T. Thanh Tran, T. Ngoc Tran, T. Van Nguyen and H. Y. Kong	2014	authorintroduce that a single secondary transmitter, ST, employs a quadrature-phase-based signal to present the secondary message, while the primary message is presented by an in-phase-based signal
4	A Cooperative Spectrum Sharing Networking Based on Labor-Consumption Model	D. Liu, W. Wang and W. Guo	2013	authorconsider a power constrained cooperative spectrum sharing network and model it as a labor-consumption market.
5	Cooperative Spectrum Sharing in Relay-Trading Mode: A Fairness View	L. Liu, G. Hu, M. Xu and Y. Peng	2012	In this paper authorproposed a cooperative spectrum sharing strategy (RT-CSS) for the relay-trading mode from the fairness view
6	Analysis of multiple shared channel cooperative routing in OFDM based wireless networks	X. Chen, A. D. S. Jayalath, G. Munasinghe and K. Ziri-Castro	2011	In this paper authoranalyze and evaluate the performance of a novel routing protocol with multiple cooperative nodes which share multiple channels

A. Saha, C. K. De, A. Nandi and D. De[1]Performance of a cooperative spectrum sharing with the help of a multi-antenna based cognitive relay (CR) employing best relay selection strategy is analyzed in presence of non-identical Rayleigh fading channel in this paper. A cognitive relay equipped with multiple antennas at the input employs selection combining (SC) on the signals received from secondary user source (S) via multiple receiving antenna at the input and forwards the received signal to secondary user destination (D) using a Amplify-and-Forward (AF) and Decode-and-Forward (DF) protocols. The outage probability performance has been evaluated, when received signals are coherently combined at both the relays with multi-antenna and destination using Selection Combining (SC) and Best Relay (BS) selection schemes respectively. The effects of number of relay antennas (L) and number of relays (K) on the system performance have also been studied. A tradeoff between relay antennas and number of relays is also indicated.

Y. Li, Y. Li, B. Cao, M. Daneshmand and W. Zhang[2]Cooperative spectrum sharing increases the spectrum efficiency and improves the performance of primary users (PUs) in cognitive radio domain. This paper proposes an energy-aware dynamic spectrum sharing framework, named Cooperative Spectrum Sharing with Energy-save(CSSE), which maximizes energy saving while ensures communication QoS (i.e. transmission rate) of primary transmitter (PT). In CSSE, the PT leverages a proper set of secondary transmitters (STs) as cooperative relays for its transmission and releases a proportion of bandwidth to the cooperative STs. Under the restriction of energy budget, each ST decides its power density allocation (including relaying power density and transmit power density for its own transmission) to maximize its transmission rate. Taking the users' selfishness and intellectuality into consideration, authorformulate the above optimal problem as a Stackelberg game (SG) and prove that a Unique Nash Equilibrium (UNE) point exists among the non-cooperative STs. Theoretical analysis and simulation results show that the PU can obtain maximum benefit. Meanwhile, the relaying STs can get acceptable benefits under CSSE.

T. Thanh Tran, T. Ngoc Tran, T. Van Nguyen and H. Y. Kong[3]This article considers a model of cooperative spectrum sharing between primary and secondary systems in which transmission occurs in two phases. In this scheme, authorsintroduce that a single secondary transmitter, ST, employs a quadrature-phase-based signal to present the secondary message, while the primary message is presented by an in-phase-based signal. This allows simultaneous spectrum sharing without mutual interference. Therefore, an interference constraint is not necessary to protect primary operating performance from being degraded by the secondary user operations. Theoretical analysis and Simulations are then provided to confirm the superiority of the proposed scheme over the the current conventional methods.

D. Liu, W. Wang and W. Guo[4]Cooperative spectrum sharing is an effective way to improve energy and spectrum efficiency of wireless communication network. In this paper, authorsconsider a power constrained cooperative spectrum sharing network and model it as a labor-consumption market. The secondary users (SUs) offer labor, i.e., power consumed for relaying the primary user's (PU's) traffic. In order to encourage SUs to work, PU admits SUs' consumption, i.e., the licensed band accessed by SUs for their own traffics. authorsformulate the problem as an auction in a labor-consumption market repeatedly played with multiple SUs for power and time trading in cooperative spectrum sharing. Based on this model, our results show that the performances of the PU and the network are greatly improved by cooperative spectrum sharing. Moreover, the selection of SUs depends on not only their channel conditions but also their transmission needs.

L. Liu, G. Hu, M. Xu and Y. Peng[5]In the relay-trading mode of wireless cognitive radio networks the secondary user (SU) can achieve a promised spectrum access opportunity by relaying for the primary user (PU). How to utilize the exchanged resource efficiently and fairly is an interesting and practical problem. In this paper authorsproposed a cooperative spectrum sharing strategy (RT-CSS) for the relay-trading mode from the fairness view. The cooperative SUs are gathered in a cooperative sharing group (CSG), and contribution metric (CM) is proposed to measure each CSG member's contribution to CSG as well as benefit from CSG. The adjustment of CM can guarantee the fairness and efficiency of spectrum sharing. The numerical simulation shows that RT-CSS can achieve better performance than the sense-uncooperative mode.

X. Chen, A. D. S. Jayalath, G. Munasinghe and K. Ziri-Castro[6]Diversity techniques have long been used to combat the channel fading in wireless communications systems. Recently cooperative communications has attracted lot of attention due to many benefits it offers. Thus co operative routing protocols with diversity transmission can be developed to exploit the random nature of the wireless channels to improve the network efficiency by selecting multiple cooperative nodes to forward data. In this paper authorsanalyze and evaluate the performance of a novel routing protocol with multiple cooperative nodes which share multiple channels. Multiple shared channels cooperative (MSCC) routing protocol achieves diversity advantage by using cooperative transmission. It unites clustering hierarchy with a bandwidth reuse scheme to mitigate the co-channel interference. Theoretical analysis of average packet reception rate and net work throughput of the MSCC protocol are presented and compared with simulated results.

III. PROBLEM IDENTIFICATION

Fixed relaying simplified the implementation of the cooperative communication network since the relay nodes always forward the information to the destination node in deterministic manner. However, this scenario does not possess high efficiency, since the received signals at relay nodes may not be good enough to be forwarded to the destination, which is the usual case due to the bad channel condition or high noise level. Adaptive relaying scenario is a means to mitigate the inefficiencies of fixed relaying, by employing different scenarios in forwarding the information.

IV. CONCLUSION

Recently, due to the increasing interest for the new wireless services, the demand for radio spectrum has increased dramatically. But, in the current spectrum management policy, it is very difficult to find a spectrum for a new wireless service because most of the spectrum has already been allocated. Therefore, there is a spectrum scarcity in particular spectrum bands. On the contrary, a large portion of the assigned spectrum is used sporadically, leading to under-utilization of a significant amount of spectrum. In the typical spectrum usage for a range of frequencies, certain portions of the spectrum are heavily used, some are partially used and others are sparsely used.

In this paper the survey of cooperative system based on Adaptive hybrid relay techniques.

REFERENCES

[1]. Saha, C. K. De, A. Nandi and D. De, "Cooperative spectrum sharing with multi antenna based Amplify-and-Forward and Decode-and-Forward Relay," 2016 IEEE Uttar Pradesh Section International Conference on Electrical, Computer and Electronics Engineering (UPCON), Varanasi, 2016, pp. 224-228.

[2]. Y. Li, Y. Li, B. Cao, M. Daneshmand and W. Zhang, "Cooperative Spectrum Sharing with Energy-Save in Cognitive Radio Networks," 2015 IEEE Global Communications Conference (GLOBECOM), San Diego, CA, 2015, pp. 1-6.

[3]. T. Thanh Tran, T. Ngoc Tran, T. Van Nguyen and H. Y. Kong, "Use of in-and-quadrature phase signals for cooperative spectrum sharing," 2014 International Conference on Advanced Technologies for Communications (ATC 2014), Hanoi, 2014, pp. 193-197.

[4]. D. Liu, W. Wang and W. Guo, "A Cooperative Spectrum Sharing Networking Based on Labor-Consumption Model," 2013 IEEE 78th Vehicular Technology Conference (VTC Fall), Las Vegas, NV, 2013, pp. 1-5.

[5]. L. Liu, G. Hu, M. Xu and Y. Peng, "Cooperative Spectrum Sharing in Relay-Trading Mode: A Fairness View," 2012 International Conference on Cyber-Enabled Distributed Computing and Knowledge Discovery, Sanya, 2012, pp. 419-422.

[6]. X. Chen, A. D. S. Jayalath, G. Munasinghe and K. Ziri-Castro, "Analysis of multiple shared channel cooperative routing in OFDM based wireless networks," IET International Communication Conference on Wireless Mobile and Computing (CCWMC 2011), Shanghai, 2011, pp. 175-180.