Volume 66, Issue 6, June 2017, Article number 7733122, Pages 5372-5386

New Bandwidth Efficient Relaying Schemes in Cooperative Cognitive Two-Way Relay Networks with Physical Layer Security

El-Malek, A.H.A.[a], Salhab, A.M.[b], Zummo, S.A.[b]

[a] Department of Electrical Engineering, Pharos University in Alexandria, Alexandria, 21523, Egypt

[b] Department of Electrical Engineering, King Fahad University of Petroleum and Minerals, Dahran, 34464, Saudi Arabia

Abstract:

In this paper, a new cooperative two-way cognitive relaying scheme is proposed. In this model, a primary user (PU) network consisting of two PU sources communicate with each other via a single amplify-And-forward (AF) relay. In addition, a secondary user (SU) source transmits its data to an SU destination via the same PU relay node. To mitigate the SU interference caused to the PU network, the PU network considers the SU network pairs as two additional relay nodes helping the original PU relay node in improving the PU network performance. As a reward for its cooperation, the PU network allows the SU network to communicate simultaneously via the PU relay node by using the decode-And-forward protocol. The proposed system allows the transmission of four PU symbols and one SU symbol in four/three time slots resulting in a bandwidth efficiency of 1.25/1.67 based on the cooperative scheme, respectively. Two power allocation optimization problems are formulated: The first problem minimizes the weighted sum of the average symbol error probability of both PU and SU systems, whereas the second problem maximizes the total achievable sum rate of the PU and SU networks. Lagrangian multiplier method is used to find the optimal solutions for both problems under the constraint of maximum allowable power budget. In addition, the paper investigates how the proposed model improves the PU physical layer security performance against a single passive eavesdropper. The results show that the error performance of the proposed relay selection model outperforms the conventional two-way relaying networks with AF protocol. Moreover, findings illustrate that the total achievable sum rate of the proposed relay elimination model is higher than the total achievable rate of the conventional two-way relaying model. From secrecy point of view, the proposed model is shown to achieve a nonzero secrecy rate that improves the PU system security against eavesdropping attacks. © 1967-2012 IEEE.

Volume 66, Issue 6, June 2017, Article number 7733122, Pages 5372-5386