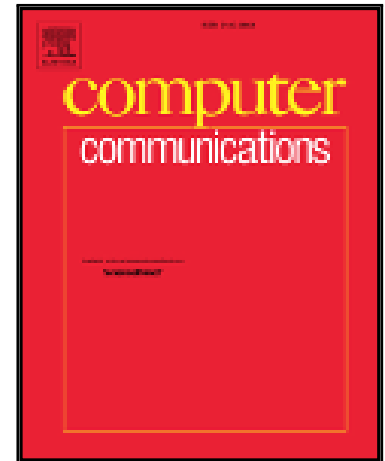


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Performance analysis of Underlay Cooperative Cognitive Full-duplex Networks with Energy-Harvesting Relay

Pham Ngoc Son¹, Tran Trung Duy²

Abstract

In this paper, we propose an underlay cooperative cognitive network (UCCN), where an energy-harvesting (EH) two-antenna relay operating on full-duplex (FD) mode is used to assist a secondary source to forward the data to a secondary destination (FDEHSN protocol). In the FDEHSN protocol, the secondary relay harvests the energy from the radio-frequency signals of the secondary source in the first interval before performing simultaneously the receiving and transmitting processes in the remaining interval. We derive asymptotic closed-form expressions of outage probability and throughput over Rayleigh fading channel. Contributions show that the FDEHSN protocol outperforms a conventional full-duplex UCCN without using the EH architecture (WoEH protocol) in terms of outage probability and a conventional half-duplex UCCN with using the EH architecture (UCCN-TS protocol) in terms of throughput. When the EH time ratios are obtained by Golden Section Search approach in order to minimize the outage performance for the proposed protocol, the throughput of the FDEHSN protocol is enhanced and exceeds that of the WoEH one while the impacts of residual loopback interference are serious. In addition, the effects of the energy conversion efficiency and locations of the primary receiver and the secondary relay on the system performance of the secondary network are presented and discussed. Finally, the asymptotic outage probability and corresponding throughput are valid with Monte Carlo simulation results.

Keywords: Full-duplex, energy harvesting, cooperative communication, underlay protocol, interference constraint, loopback interference

1. Introduction

Recently, cognitive radio (CR) and full-duplex (FD) techniques have gained much attention as being promising solutions to obtain spectrum utilization efficiency. In the CR technique [1, 2, 3], unlicensed users or cognitive users in secondary networks opportunistically access frequency spectrum of licensed users in primary networks. Underlay CR has emerged as an efficient spectrum sharing

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