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Implementation of D&F Relay Node for Cooperative MIMO Systems through SDR platform

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ABSTRACT

In recent years, relaying networks are promising for future wireless communication systems, which profoundly enhance link capacity and exploiting cooperative diversity. In this paper, we propose a prototype of a Decode-&-Forward (D&F) Relay Node system based on Software Defined Radio (SDR) using Universal Software Radio Peripheral (USRP) and MatlabTM software. The developed testbed platform allows implementing and test new algorithms and specifications for LTE/LTE-A and 5G. Both Single-Input Single-Output (SISO) and Multi-Input MultiOutput (MIMO) are supported in our testbed. The considered D&F MIMO cooperative system in this paper utilizes Orthogonal Space-Frequency Block Codes (OSFBCs) for the transmission of the data symbols of the source to the destination. The transmission data from eNB has been measured using commercial 4G/5G measurement equipment. It has been demonstrated that D&F cooperative system substantially improves the Bit Error Rate (BER) and throughput of the user, taking higher performance with the 2×2 MIMO technique. Index Terms—Decode-&-Forward, Relay Node, SDR, MIMO, BER, Throughput

1. INTRODUCTION

At present, wireless communications are being focused to achieve higher data rates, channel capacity, better connectivity, and mobility [1]. In this sense, Relay Nodes (RNs) have captured significant attention in the research community due to that can be implemented to increasing customer demands, extend cell-edge coverage, reduce the power transmission from evolved Node-B (eNB) to users equipment (UEs) and increase the system capacity [2]. Consequently, several system models involving RNs have been proposed in the literature, where a stage of intermediate nodes helps the transmitter to communicate with a receiver using shared radio resources [3]. The 3GPP has addressed the study and standardization of RNs in several releases [4], [5]. It should be noted that most of the works described above analyze the network performance in theory or by simulation [6], [7]. Currently, there are some testbed development platforms, which are suitable for RNs research and implementation. Software Defined Radio (SDR) has been a promising way for the development and configuration of Physical Layer (PHY), Medium Access Control Layer (MAC) and some Radio Link Control (RLC) with much more efficient programming environment. Universal Software Radio Peripheral (USRP) with Labview and GNU Radio have been used widely as SDR platform these days [8]– [10] the design and implementation of a complete functional testbed framework based on the SDR platform and MatlabTM is presented. The key target is to develop a D&F Relay Node to evaluate the real performance and viability for its implementation through a 2×2 MIMO SDR platform. In addition, the authors focus on the study of downlink performance in an indoor-to-indoor scenario, using the 64-QAM modulation scheme and the 2×2 Transmission Diversity MIMO technique. The millimeter wave technology has been known for many decades, and it has been deployed for military applications. With the advances of process technologies and low-cost integration solutions, this technology has started to gain a great