Chapter 3
Comprehensive Performance Analysis of Uplink and Downlink Transmission in NOMA–OFDM Systems

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ABSTRACT

As wireless communication systems evolve to meet growing demands for high data rates and efficient connectivity, the integration of Non-Orthogonal Multiple Access (NOMA) with Orthogonal Frequency Division Multiplexing (OFDM) offers significant potential for enhancing system performance. This chapter presents a study on performance analysis of uplink and downlink transmissions in NOMA- OFDM systems, focusing on optimizing resource allocation for both data transmission and wireless power transfer (WPT). The system under consideration utilizes power splitting technology at mobile users to simultaneously decode information & har-

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vest energy. We analyze the performance of the system by optimizing sub-carrier allocation, power allocation, and power splitting ratios to maximize the minimum total transmit rate for users in both uplink & downlink scenarios. The impact of imperfect CSI is also considered. We approximate the non-convex optimization problems for practical solution implementation.

INTRODUCTION

These many transmitters at the sending and receiving ends are used in single-user applications to achieve beamforming or spatial multiplexer advancements. The proposed solutions allow two different communication scenarios: one using OFDM and the other using NOMA. In both scenarios, the potential error in the CSI estimation is considered. The suggested approach solves the inherent complexity of the non-convex max-min optimization issues by approximating them as convex optimization problems. Next, present an asynchronously efficient algorithm for the OFDM case and a sub-optimal strategy for the NOMA case, (Zhang et al., 2017). Finally, using numerical analyses, a comprehensive validation and performance assessment of the recommended resource allocation strategies was completed. Problem identification, strategy development, computational approach development, and comprehensive evaluations of efficiency are all included in this comprehensive process, (Do et al., 2020).

Resource allocation systems are designed to address these issues by making the transmission of wireless power in a relay-assisted FD wireless connection easier. While mobile users use relay assistance to transmit uplink (UL) information to the AP, the AP handles Wireless Data and Power Transfer to numerous mobile users in the downlink (DL). DL WIPT is predicated on the idea that every mobile user will apply power splitting technology to simultaneously harvest energy while gathering information, (Choi & Seo, 2019). These suggested systems, which optimize subcarrier as well as power utilization, relay, and capacity splitting ratio selection jointly, aim to maximize the minimal total of DL as well as UL transmission rates to guarantee user fairness, (Tabassum et al., 2017).

The power-domain NOMA approach, according to Saito et al. (2013), allows numerous devices to use shared time and frequency elements concurrently, improving the spectrum utilization effectiveness of mobile networks. A multiple-user-friendly data model serves as the conceptual foundation for the PD NOMA system, which encompasses a range of transmitting and receiving structures, communicating systems, combination the field of computing, ordered disruption abandonment, joint decoding, incremental water filling, large coding, and scalars and the vector multi-access (MA) systems, (Liu et al., 2017). It is noteworthy, however, that NOMA

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