Received: 29 August 2022 | Revised: 12 September 2022 | Accepted: 12 September 2022
DOI: 10.37917/ijeee.19.1.7 Vol. 19| Issue 1| June 2023

Open Access

Iraqi Journal for Electrical and Electronic Engineering
Original Article

Enhancement Spectral and Energy Efficiencies for Cooperative NOMA Networks

Haider S. Msayer*[1,2], Husham L. Swadi[1], Haider M. AlSabbagh[1]
[1] Department of Electrical Engineering, College of Engineering, University of Basrah, Basrah, Iraq.
[2] Basra Oil Company (BOC), Basrah, Iraq.

Correspondence
*Haider Shaker Msayer
Department of Electrical Engineering,
College of Engineering, University of Basrah,
Basrah, Iraq.
Email: haidermsc2020@gmail.com

Abstract
The tremendous development in the field of communications is derived from the increasing demand for fast transmission and processing of huge amounts of data. The non-orthogonal multiple access (NOMA) system was proposed to increase spectral efficiency (SE) and improve energy efficiency (EE) as well as contribute to preserving the environment and reducing pollution. In the NOMA system, a user may be considered as a relay to the others that support the coverage area based on adopting the reuse of the frequency technique. This cooperation enhances the spectral efficiency, however, in the cell, there are other users that may affect the spectral allocation that should be taken into consideration. Therefore, this paper is conducted to analyze the case when three users are available to play as relies upon. The analyses are performed in terms of the transmitted power allocation in a fair manner, and the system's performance is analyzed using the achievable data rates and the probability of an outage. The results showed an improvement in throughputs for the second and third users, as its value ranged from 7.57 bps/Hz to 12.55 bps/Hz for the second user and a quasi-fixed value of 1,292 bps/Hz for the third user at the transmitted power ranging from zero to 30 dBm.

KEYWORDS: Energy Efficiency, Spectral Efficiency, Cooperative Non-Orthogonal Multiple Access, Relay.

I. Introduction

The mature 4G networks were successfully applied in different types of wireless communications to satisfy the increasing demand for cellular data traffic that have high capacities and speed. However, the demand was ambitious to enhance connecting ALL things through the internet that required a considerable attention to allocate the available limited spectral [1].

Researchers turned to 5G with some new protocols to support high speed and a large capacity that need a very high bandwidth to enhance the spectrum efficiency [2,3]. The trend towards 5G meets many requirements of the tremendous technological development that is increasing exponentially, it provides capacities 1000 times more than 4G with a large bandwidth and very high speeds of up to 10 Gigabits per second. This unprecedented technological progress requires the provision of Infrastructures that accommodate the massive increase of devices served by 5G networks [1,4].

Transformation to 5G requires a rise in energy consumption, a significant increase in energy bills, and an increase in the operating costs of the mobile phone network, as energy increase leads to serious creates significant environmental, economic and financial risks to the world [5]. The increased energy consumption, the rise greenhouse gas emissions, the large carbon footprint, the increased health concerns on humans and the environment and the strive to extend the battery lifetime of smart devices. All these challenges lead to the term green communication (GC) [6].

The quest to make the 5G and beyond to improve energy efficiency and to increase sources of clean energy, preserve the environment from high carbon, preserve primary energy sources from overuse and search for alternative sources that reduce pollution in the world, as well as reduce operational expenses that burden the field of communications financially and economically [7].

5G networks operate with higher bandwidth than previous generations, this allows them to have a high download speed of up to 10 G /sec and with the increase in bandwidth that will serve cellular networks. In addition to being used as an Internet service provider in general for all mobile and desktop devices and to support new applications in the Internet-of-Things (IoT) and machine-to-machine domains [8,9].