جامعة الإسكندرية
ALEXANDRIA
UNIVERSITY

Faculty of Engineering
Department of Electrical Engineering

PERFORMANCE OPTIMIZATION OF ENERGY-EFFICIENT CLOUD RADIO ACCESS NETWORK

A Thesis submitted in partial fulfillment of the requirements for the degree of Master of Science

In

Electrical Engineering

Presented by

Eng/ Maha Fathy Hussein Kamel

B.Sc. Electrical Engineering,
Faculty of Engineering, Pharos University, 2013

2018

ABSTRACT

Cloud Radio Access Network (Cloud-RAN) has recently been proposed as a promising network architecture to maintain both profitability and quality of service (QoS) of the ever-growing existing networks. It may be considered as one of the major achievements and developments happening to fulfil next generation 5G networks goals and overcome their existing challenges.

This thesis introduces an optimization study for improving the performance of Cloud-RAN targeting minimized consumed power for the network. The network power consumption minimization problem can be formulated as a Joint RRH selection and power minimization beamforming problem. We adapt two algorithms in literature, which are greedy selection (GS) algorithm and Bi-Section Group Sparse beamforming (Bi-Section GSBF) algorithm. We propose two optimization approaches, which are heuristics-driven approach and trained artificial neural network approach. The main target is decreasing the number of active Remote Radio Heads (RRHs) and optimizing the transmitted power from RRHs to end users maintaining heterogeneous users' QoS requirements.

The first optimization proposed approach suggests heuristics-driven approach, considering near-optimum inactive RRHs numbers at low users' QoS requirements and at high relative power consumption of the fronthaul network.Then, this approach applied to the optimization problem to further reach near-optimum solutions of power consumption in the network and to reduce the problem time complexity for both employed (GS and Bi-Section GSBF) algorithms.

The second optimization approach uses a trained artificial neural network-based reasoning model which is employed with the Bi-Section GSBF algorithm to obtain better near-optimum solution (i.e., number of active RRHs) in the network as well as reduce time complexity. Applying this trained model improves the heuristics-driven of Bi-Section Group Sparse beamforming algorithm results in both network power consumption and time complexity.

Obtained simulation results of both proposed approaches are coupled with a statistical analysis (i.e., confidence interval) method. Statistical validated results show reduction in power consumed and in time complexity. Furthermore, the proposed artificial neural network-based optimization approach outperform the heuristic-driven approach in achieving small active number of running RRHs, improving power efficiency, and reducing time complexity.