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Energy-efficient 5G cloud RAN with virtual BBU server consolidation and base station sleeping

Tshiamo Sigwele ^a, Yim Fun Hu ^{1, b}, Misfa Susanto ^c[Show more](#) <https://doi.org/10.1016/j.comnet.2020.107302>[Get rights and content](#)

Abstract

Heterogeneous network (HetNet) deployment where macro cells are overlaid by small cells is considered a de-facto solution for meeting the ever increasing mobile traffic demand in fifth generation (5G) networks. However, deployment of a large number of small cell base stations (BSs) result in considerable increase in HetNet energy consumption. Cloud radio access networks (C-RAN) has been proposed as an energy-efficient architecture that leverages cloud computing technology where baseband processing is performed in virtual baseband units (vBBU) in the BS cloud. In this paper, we address the energy efficiency (EE) optimization problem in the downlink for two-tier heterogeneous C-RAN (H-CRAN) comprising of macro and pico-cells. At the radio side of H-CRAN, a dynamic pico BS switching OFF algorithm based on a utility function is proposed while maintaining coverage and quality of service (QoS). In the cloud side, heuristic approximation algorithms are proposed including simulated annealing (H-CRAN SA) and genetic algorithm (H-CRAN GA) to minimize energy consumption by reducing the number of BBU servers used through vBBU placement. The proposed scheme is compared with distributed long term evolution advanced (LTE-A) Hetnet system and simulation results show that the proposed H-CRAN SA and H-CRAN GA schemes save 48% and 45% of energy on a daily average, respectively while maintaining the required QoS.



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Keywords

Cloud computing; C-RAN; 5G; Virtual machine placement; Simulated annealing; Genetic algorithm; Energy-efficiency

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Dr Tshiamo Sigwele is currently a Lecturer Botswana International University of Science and Technology (BIUST) with research interests in Cloud Computing, Semantic Web and Ontology, Semantic Interoperability in Healthcare and Wireless communication. Dr Sigwele hold a Ph.D. in Cloud Computing and Telecommunications from the University of Bradford in UK. He has over 15 internationally recognized publications. He worked as researcher from 2017 to 2018 in a British Council Funded project BLESS U - Bandar Lampung Enhanced Smart Health Services with Smart Ubiquity of Grant Total € 89,937.



Prof Yim Fun Hu is Head of Biomedical and Electronic Engineering in the University of Bradford. Professor Fun Hu is Professor of Wireless Communications Engineering since 2005 and the holder of the Yorkshire Forward Chair in Wireless Communications (2007). Since starting her academic career in 1992, Prof. Hu has received considerable funding support through participations and contributions to many flagship projects funded by the UK funding councils, the EU, ESA and TSB. Much of her research activities have been conducted in collaboration with industry and other universities and research organisations over the globe. Her major research is in integrated mobile, wireless and satellite communication networks with applications to vehicular communications networks including aircrafts and trains. She is the Head of the Future Ubiquitous Research Group, which has 3 academic staff, 7 research staff and numerous research students. Prof. Hu has published over 100 papers in scientific journals and international conferences, and have co-authored 1 book, edited two books and contributed to 5 book chapters. She is currently the Head of the Biomedical & Electronics Engineering Department in the Faculty of Engineering and Informatics.



Dr Misfa Susanto obtained his Doctor of Philosophy at the University of Bradford. His main areas of research are network coding and wireless communications. He is currently a Lecturer at University of Lampung, Indonesia in the Department of Electrical Engineering, Faculty of Engineering.

¹ Member, IEEE

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