INTERFERENCE MANAGED HYBRID CLUSTERING TECHNIQUES TO IMPROVE 5G RADIO RESOURCE MANAGEMENT

NAUREEN HASAN
02-284162-001

BAHRIA UNIVERSITY KARACHI

Approval for Examination

Scholar's Name: Naureen Hasan Registration No:. 46447

Program of Study: Ph. D (CS)

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Name: **Dr. Safdar Ali Rizvi**

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Dedication

This dissertation is dedicated to my beloved parents and husband who always encouraged and helped me in achieving my goals.

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Firstly, I am highly thankful to Allah Almighty who made this possible for me to achieve. I witness the moments when Allah (SWT) made things possible for me and granted me success. Allah (SWT) gave me strength and motivation in completing the work that I started.

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Abstract

To meet the projected growing demand of future networks, 5G Heterogeneous Network (HetNet) is expected to provide seamless connectivity among the network nodes. In addition, it enable the base-stations and mobile users to maintain consistent data transmission rates in indoor and outdoor locations. To attain such internetworking environment, 5G networks have to guarantee high data throughput, enhanced network capacity, and scalability with reduced network interference and latency compared to previous cellular technologies. However, due to the scarce radio resource availability and conventional network deployment strategies, attainment of these parameters is difficult. Therefore, to achieve an efficient radio resource management mechanism in heterogeneous networks, a novel clustering architecture is proposed in this thesis.

The clustering technique can be performed in various ways such as centralized, distributed, and hybrid clustering methods. Nevertheless, the issue of compromised throughput, limited capacity, and high interference persists. This research work contributes a two-fold strategy. Firstly, an efficient hybrid clustering algorithm is proposed, named as Interference-Managed Hybrid Clustering (IMHC) mechanism. The IMHC mechanism categorizes the small cell base stations (SBSs) as High-power SBSs (HSBSs) and Low-power SBSs (LSBSs) based on their transmitting power by introducing small-cell power control (SPC) algorithm. By analyzing the simulation results, it can be concluded that the IMHC mechanism under the orthogonal frequency division multiple access (OFDMA) for SBSs in a three-tier heterogeneous network addresses the issue of co-tier and cross-tier interference. Consequently, by reducing the interference it improves the network throughput and the Signal to Interference Ratio (SIR) at different tiers of HetNet. By managing the small cell nodes of similar power levels at the individual tiers i.e. Pico cells at tier -2, and Femto cells at tier-3, the co-tier and the cross-tier interference are reduced. However, even by implementing the IMHC mechanism still the outlier nodes experiences the issue of low signal reception. Therefore, to improve the signal reception at all users within the network the Power Domain – Non Orthogonal Multiple Access (PD-NOMA) scheme is considered.

Therefore, to further improve the Radio Resource Management (RRM) and achieve a robust user association emphasizing the edge users within the given mechanism an adaptive scheme is proposed. In this step, clustering with cooperative (PD – NOMA) is performed which resulted in an improved performance of a clustered heterogeneous network. Additionally, to improve user association and network performance the proposed technique employs a clustered cooperative PD-NOMA algorithm that limits the number of users associated per cluster. The research has improved the user association, resulting in an increase in system capacity, system throughput, and sum-rate in an ultra-dense heterogeneous network with decreased interference and latency. Statistically, improved results are achieved with the proposed scheme in terms of throughput by 65% when compared with the clustered OFDMA scheme and 23% when compared with the unified PD-NOMA scheme. With a varying number of randomly placed users range from 2 – 80 users and the randomly deployed femto base stations up to 1000 and the number of pico base stations are considered to be 100. For the assumed scenario the system capacity has increased by 8% when compared with unified PD-NOMA and approximately 80% as compared to the clustered OFDMA scheme as previously studied. Thus, with this research an efficient radio resource management clustered topology is achieved along with an interference abating power controlling algorithm for the future networks.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

Acronym	Description
SBS	Small Cell Base Station
MBS	Macro Cell Base Station
HSBS	High-Power Small Cell Base Station
LSBS	Low-Power Small Cell Base Station
UDN	Ultra-Dense Network
IMHC	Interference-Managed Hybrid Clustering
SPC	Small Cell Power Control
CH	Cluster Head
CM	Cluster Member
SGW	Small Cell Gateway
SIR	Signal To Interference Ratio
PPP	Poisson Point Process
NOMA	Non Orthogonal Multiple Access
RRM	Radio Resource Management
RAN	Radio Access Network
PD - NOMA	Power Domain Non Orthogonal Multiple Access
OFDMA	Orthogonal Frequency Division Multiple Access
SIC	Signal Interference Cancellation
SNR	Signal to Noise Ratio