

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



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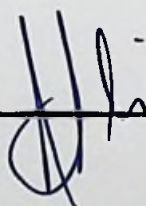
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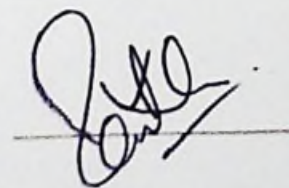
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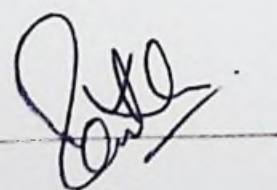
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Dedication

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

Acknowledgment

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

Approval for Examination.....	ii
Author's Declaration.....	iii
Certificate of Originality	iv
Dedication	v
Acknowledgment	vi
Abstract	vii
LIST OF TABLES.....	xii
LIST OF FIGURES	xiii
LIST OF ABBREVIATIONS	xv
CHAPTER 1	1
INTRODUCTION	1
1.1 5G Heterogeneous Network (HetNet).....	1
1.2 Ultra-Dense Heterogeneous Network (HetNet):	4
1.2.1 Small Cells in Heterogeneous Networks:	4
1.2.2 Multi-Tier Heterogeneous Network Challenges:	8
1.3 Motivation:.....	10
1.4 Radio Resource Management to Overcome Challenges:	10
1.4.1 An Essential Clustered HetNet Architecture:	11
1.4.2 An Enhanced Multiple Access Technique for Improved User Association:	11
1.5 Research Problem:	12
1.6 Aims and Objectives of Research:	12
1.7 Scope, Assumptions, and Limitations:	12
1.8 Significant Contributions:	14
1.9 Thesis Organization:	17
1.10 Chapter Summary:	18
CHAPTER 2	19
BACKGROUND AND LITERATURE REVIEW	19
2.1 Wireless Communication Network:	19
2.2 Cellular Networks:	20
2.3 Radio Resource Management:	21
2.3.1 Implementing Clustering:	22
2.3.2 Reducing Interference and Maximizing Throughput in Dense HetNet:	24
2.3.3 Improved Sum Rate and Capacity:	26
2.4 Transmission Power Control (TPC) In Heterogeneous Networks:	27

2.5 Existing Techniques to Achieve Efficient RRM:.....	28
2.5.1 Frequency Reuse:.....	29
2.5.2 Graph Theory:	29
2.5.3 Power Minimization:.....	30
2.5.4 Stochastic Resource Allocation:	30
2.5.5 Distributed Learning:.....	31
2.5.6 Cognitive Radio Resource Management:.....	32
2.5.7 Clustering:	32
2.6 Interference Management:	34
2.6.1 Interference Mitigation Techniques	35
2.6.2 Distributed Interference Management.....	35
2.6.3 Orthogonally Interference Avoidance:.....	36
2.6.4 Co-Tier Interference:.....	37
2.6.5 Cross-Tier Interference:	37
2.7 Clustering Scheme:	46
2.7.1 Clustering Objectives:	47
2.7.2 Advantages of Clustering:	48
2.8 Classification of Clustering:.....	51
2.8.1 Centralized Clustering:	51
2.8.1.1 ADVANTAGES OF CENTRALIZED CLUSTERING (CC):	52
2.8.1.2 LIMITATIONS:	53
2.8.2 Distributed Clustering:.....	53
2.8.2.1 ADVANTAGES OF DISTRIBUTED CLUSTERING:	54
2.8.2.2 LIMITATIONS:	54
2.8.3 Hybrid Clustering:.....	55
2.9 Clustering with Non-Orthogonal Multiple Access (NOMA) Scheme:	60
2.9.1 Existing PD - NOMA Techniques:	62
2.9.2 Challenges of PD-NOMA:	65
2.10 Load Balancing in Ultra-Dense Heterogeneous Network:.....	66
2.10.1 Load Balancing in Small Cell Clusters:	67
2.11 Chapter Summary:	68
CHAPTER 3	69
RESEARCH METHODOLOGY	69
3.1 Research Methodology and Work Flow	69
3.1.1 Description of the Scheme:.....	71
3.2 Proposed Hybrid Clustered Architecture:	72

3.3 Interference Managed Hybrid Clustering Algorithm (IMHC):.....	79
3.3.1 IMHC—Pseudo Code	79
3.3.2 Small Cell Power Control Algorithm for clustered SBSs (SPC):.....	81
3.4 User Association and Power Allocation with Cooperative PD – NOMA:	86
3.4.1 Role of PD-NOMA in IMHC Algorithm:.....	87
3.4.2 Power Domain-Non Orthogonal Multiple Access (PD-NOMA):	87
3.4.3 System Model of Proposed Clustered PD-NOMA Algorithm:	89
3.4.4 Clustered PD-NOMA:.....	90
3.4.5 Power Allocation:	93
3.5 Significance of using Quality Threshold for Load Balancing in Hybrid Clusters:	95
3.5.1 Enhanced Capacity:	97
3.6 Chapter Summary:	98
CHAPTER 4	99
RESULTS AND DISCUSSION	99
4.1 Simulation Tool and Performance Metrics:	99
4.2 Simulation Environment	101
4.2.1 Poisson Point Process (PPP):	102
4.2.2 Fading and Shadowing:	103
4.3 Radio Resource Management Parameters.....	104
4.3.1 Coverage Probability:	104
4.3.2. Throughput:	105
4.3.3. Capacity:.....	106
4.3.4. Sum Rate:	106
4.3.5. Signal to Interference Ratio (SIR):	107
4.3.6. User Association:.....	107
4.3.7 Fairness:	107
4.4 Simulation Results of Interference Managed Hybrid Clustering Algorithm:	108
4.5 Simulation Results of Co-operative PD-NOMA with Hybrid Clusters:	121
4.6 Chapter Summary:	130
CHAPTER 5	131
CONCLUSION	131
5.1 Conclusion	131
5.2 Analysis.....	132
5.3 Future Work:	134
REFERENCES	135
List of Research Articles (Thesis Related Publications):.....	143

LIST OF TABLES

TABLE 2. 1 COMPARATIVE ANALYSIS OF VARIOUS APPROACHES APPLIED FOR RADIO RESOURCE MANAGEMENT IN HETNETS.....	33
TABLE 2 .2 EXISTING WORK ON RADIO RESOURCE MANAGEMENT.....	39
TABLE 2 .3 TAXONOMY OF CLUSTERING TECHNIQUES.....	45
TABLE 2 .4 EXISTING WORK ON VARIOUS CLUSTERING TECHNIQUES.....	47
TABLE 2 .5 DIFFERENT HYBRID APPROACHES UTILIZED TO OPTIMIZE DIFFERENT NETWORK PERFORMANCE PARAMETERS.....	56
TABLE 2 .6 EXISTING WORK ON PD-NOMA	62
TABLE 4.1 IMHC - SIMULATION PARAMETERS	109
TABLE 4.2 COOPERATIVE PD - NOMA SIMULATION PARAMETERS	122
TABLE 4.3 DELAY AND THROUGHPUT VS. NUMBER OF NODES PER CLUSTER.....	128
TABLE 5.1 SUMMARY OF IMPROVED THROUGHPUT WITH THE IMHC SCHEME.....	133
TABLE 5.2 SUMMARY OF IMPROVED RESULTS WITH THE COOPERATIVE CLUSTERED PD- NOMA SYSTEM.....	133

LIST OF FIGURES

FIGURE 1. 1 A HETEROGENEOUS NETWORK [2]	2
FIGURE 1. 2 RADIO RESOURCE MANAGEMENT CHALLENGES	9
FIGURE 1. 3 GRAPHICAL REPRESENTATION OF RESEARCH PROBLEM.....	14
FIGURE 2. 1 THE CROSS-TIER INTERFERENCE IN HETNET	25
FIGURE 2. 2 TECHNIQUES TO MANAGE RADIO RESOURCE ALLOCATION ISSUES IN DENSE 5G HETNETS	28
FIGURE 2. 3 A CLUSTERING TOPOLOGY IN HETNET	49
FIGURE 2. 4 A CENTRALIZED CLUSTERING TOPOLOGY.....	52
FIGURE 2. 5 DISTRIBUTED CLUSTERING TOPOLOGY	54
FIGURE 2. 6 CATEGORIZATION OF CLUSTERING ALGORITHMS.....	56
FIGURE 2. 7 HYBRID CLUSTERING IN HETNETS FOR OPTIMIZED RRM	58
FIGURE 3. 1 RESEARCH WORK FLOW.....	70
FIGURE 3. 2 IMHC HETNET MODEL.....	73
FIGURE 3. 3 STEP-WISE RESEARCH CONTRIBUTION MODEL	74
FIGURE 3. 4 POWER DISSEMINATION WITHIN THE 3 – TIER HETNET	78
FIGURE 3. 5 PROCESS FLOW OF THE IMHC HYBRID CLUSTERING SCHEME	82
FIGURE 3. 6 PD NOMA WITH 2 USERS.....	88
FIGURE 3. 7 SYSTEM MODEL OF CLUSTERED PD-NOMA IMPLEMENTED AT A SBS-TIER ON RANDOMLY DEPLOYED ULTRA-DENSE	90
FIGURE 3. 8 SUB CHANNEL ASSIGNMENT	92
FIGURE 3. 9 HETNET CLUSTERS SHOWING MULTIPLE TIERS ALSO THE CELL RANGE EXPANSION DUE TO INCLUSION	97
FIGURE 4. 1 VORONOI TESSELLATION OF RANDOMLY DEPLOYED NODES UNDER POISSON DISTRIBUTION.....	105

FIGURE 4.2 VORONOI TESSELLATION OF SIMULATION SCENARIO IN A HETNET ENVIRONMENT OVER AN AREA OF 5KM	108
FIGURE 4. 3 SIMULATION SCENARIO OF THE PROPOSED SCHEME.....	110
FIGURE 4. 4 SIMULATION METHODOLOGY OF THE PROPOSED SCHEME.....	110
FIGURE 4. 5 A DENDROGRAM OF THE HSBS CENTRALLY CONTROLLED CLUSTERS	111
FIGURE 4. 6 SILHOUETTE REPRESENTATION OF DISTRIBUTED CLUSTERING OF LSBSS ...	112
FIGURE 4. 7 COMPARISON OF RECEIVED SIR VS. HSBS DISTANCE (M)	113
FIGURE 4. 8 COMPARISON OF RECEIVED SIR (DBM) VS. LSBS DISTANCE (M)	115
FIGURE 4. 9 SYSTEM THROUGHPUT ACHIEVED WITH THE IMHC SCHEME BY INCREASING THE NUMBER OF SBSs IN HETNET.....	117
FIGURE 4. 10 COMPARATIVE ANALYSIS OF THROUGHPUT ACHIEVED WITH THE IMHC AND THE EXISTING CLUSTERING TECHNIQUES	118
FIGURE 4. 11 SIR COMPARISONS OF HSBS AND LSBS WITHIN THE IMHC SCHEME	119
FIGURE 4. 12 AVERAGE SIR RECEIVED AT VARIOUS DISTANCES.....	119
FIGURE 4.13 CDF OF SMALL CELL BSs SIR WITH THE IMHC HYBRID CLUSTERING ALGORITHM.	120
FIGURE 4. 14 CHANNEL CAPACITY COMPARISONS UNDER THE UNIFIED PD-NOMA AND CLUSTERED PD-NOMA SCHEME	123
FIGURE 4.15 COMPARATIVE ANALYSIS OF THROUGHPUT GAIN ACHIEVED WITH THE PROPOSED SCHEME AND THE EXISTING SCHEMES	125
FIGURE 4. 16 SYSTEM CAPACITY Vs. SINR.....	126
FIGURE 4. 17 SUM RATE COMPARISON WITH MAXIMUM NUMBER OF ASSOCIATED USERS OCCUPYING THE SAME RESOURCE BLOCK	127
FIGURE 4. 18 COVERAGE PROBABILITY VS RECEIVED SIR (DBM) THRESHOLD VALUES	130

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