AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
ECE DEPARTMENT

Thesis Title

Interference Avoidance in HetNet Environments Composed of Marco-cells and Femto-cells

By

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STATEMENT

This thesis is submitted as partial fulfillment of M.Sc. degree in Electronics and Communication Engineering, Faculty of Engineering, Ain Shams University.

The Author carried out the work included in this thesis, and no part of it has been submitted for a degree or qualification at any other scientific entity.

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Abstract

Heterogeneous Network (HetNet) often indicates the use of multiple types of access nodes in a wireless network. It is a wide area network that can use macrocells, picocells, and/or femtocells in order to offer wireless coverage in an environment with a wide variety of wireless coverage zones, ranging from an open outdoor environment to office buildings, homes, and underground areas. The co-existence of multiple types of nodes in the same area offers a considerable increase in the bandwidth efficiency, namely the area spectral efficiency, as all the nodes are reusing the same bandwidth available for the macro-cell in the shared coverage area. However, this increase in the bandwidth efficiency is very promising, but this with the cost of high interference between the different HetNet nodes. In the proposed model, we address the interference problem in a HetNet environment composed of macrocells and femtocells.

Femtocells, also called Home Base Stations, are small cellular access points installed by home users to get a better indoor voice and data coverage with lower network operation cost. The deployment of femtocells in LTE cellular networks is currently being studied to enable more efficient utilization of the available spectrum.

Furthermore, Cooperation among the femtocells becomes an optimization technique to induce a fair resource allocation to the serving users. However, cooperation performance is restricted by backhaul limitations. Hence, in the proposed model, an energy efficient system design for cooperative self-organizing femtocells (SOFs) is proposed. A new spectral resource management is used to avoid the uplink co-tier interference depending on less signaling overhead resulting from cooperation organization among SOFs. A model is built for the cooperation among the SOFs for resource allocation with minimum backhaul signaling traffic. The simulation results show that the proposed model guarantees different radio blocks allocation for femto-users affected by the co-tier interference. In addition, the proposed model will reduce the traffic of the cooperation by 45% of that of the conventional model. Finally, the proposed model performance in terms of latency and power consumption for different backhaul technologies is simulated. It is found that the signaling power consumption can be reduced from 814w to 159w. Therefore, our proposed cooperation model can be considered energy efficient.

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List of Abbreviations

3GPP	3rd Generation Partnership Project
ATA	Analog Terminal Adapter
AS	Application Server
BBF	Broadband Forum
BSS	Base Station Subsystem
BTS	Base Transceiver Stations
BSC's	Base Station Controllers
BPL	Building Penetration Loss
B.W	Band Width
BCCH	Broadcast Control Channel
CPE	Customer premises equipment
CDMA	Code Division Multiple Access
CSCF	Call Signaling Control Function
CAGR	Compound annual growth rate
CR	Cognitive Radio
CSG	Closed Subscriber Group
CCI	Co-Channel Interference
CoMP	Coordinated Multipoint
CSI	Channel State Information
DL	Downlink
EPC	Evolved Packet Core
ED	Energy detection
EIC	Enhanced Inter-Cell
FMC	Fixed Mobile Convergence
FNC	Femtocell Network Controller
FUE	Femto Base Station
FBS	Femto Base Station
FAPs	Femto Access Points
FMS	Femtocell Device Management System
FCS	Femtocell Convergence Server
FNG	Femtocell Network Gateway
FDD	Frequency Division Duplex
FFR	Fractional Frequency Reuse
FIFO	First In First Out
FFT	Fast Fourier Transform
GSM	Global System for Mobile communications
GPRS	General Packet Radio Service
GSA	Global mobile Suppliers Association
HetNet	Heterogeneous Network

HSPA	High-Speed Packet Access
HLR	Home Location Register
HSS	Home Subscriber System
HeNB	Home eNodeB
IETF	Internet Engineering Task Force
ITU	International Telecommunication Union
ITU-R	ITU-Radio communication Sector
IMS	IP Multimedia Subsystem
IMT	International Mobile Telecommunication
ISC	IP multimedia Service Control
ICIC	Inter Cell Interference Coordination
LTE	Long-Term Evolution
MF	Matched Filter
MIMO	Multiple-input Multiple-output
MSC	Mobile Switching Centers
MGW	Media Gateway
MGCF	Media Gateway Control Function
MRF	Media Resource Function
MNO	Mobile Network Operator
MUE	Macro User Equipment
MME	Mobility Management Entity
NP	Neyman Pearson
OFDMA	Orthogonalfrequencydivision multiple access
PDSN	Packet Data Serving Node
PSTN	Public Telephone Network
PSAP	Public Safety Answering Point
PDN	Packet Data Network
PUs	Primary Users
PSD	Power Spectral Density
PDCCH	Physical Downlink Control Channel
QoE	Quality of Experience
QoS	Quality of Service
RTP	Real-Time Protocol
RNC	Radio Network Controller
RB	Radio Block
SOF	Self Organized Femtocells
SBS	Small Base Station
SDOs	Standard Development Organizations
SAE	System Architecture Evolution
SeGW	Security Gateway
SIP	Session Initiation Protocol
SINR	Signal to Noise Ratio