Master Thesis

Mobility Management and eICIC in LTE Femtocells

by

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Declaration

To the best of my knowledge and belief this work was prepared without aid from any other sources except where indicated. Any reference to material previously published by any other person has been duly acknowledged. This work contains no material which has been submitted or accepted for the award of any other degree in any institution.

Signature .....

Date .....

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Abstract

LTE-Long Term Evolution was proposed in Release 8 by Third Generation Partnership Project (3GPP) with a new Radio Access Network (RAN) and an Evolved Packet Core (EPC) Network to provide a smooth migration to 4G network. The number of mobile subscribers and data usage have increased exponentially since the roll-out of LTE because of new higher capacity LTE air-interface. This has created new challenges for the network operators to provide a satisfactory quality of service to the mobile users especially in indoor scenarios.

One solution to provide better indoor user experience in a cost effective manner is use of femtocells which were introduced in 3GPP LTE, Release 8. Femtocells are short ranged indoor small cells, which share the same spectrum with macrocell and could have a limited user access. Higher data rate, improved indoor coverage, QoS and longer battery life could be achieved with the deployment of femtocells. Nonetheless, the plug-and-play capability and lower cost of these small cells pose huge interference problems in uplink and downlink when installed in dense urban areas and in an unplanned way.

Interference management and handover are two important factors to be considered while implementing LTE network with femtocells. The use of hard handover in 3GPP LTE and LTE-A systems coupled with the absence of a direct signaling interface between macrocell and femtocell may cause call drops and delay in mobility management. The objective of this research is to address the challenges posed by handover performance and interference mitigation in LTE system with femtocells.

In this work, a speed based handover algorithm is proposed,

simulated in LTE-SIM and optimized by introducing Almost Blank Sub-Frames (ABSF) and Cell Range Expansion (CRE) interference coordination schemes. Simulation results show that, better user experience can be achieved in terms of delay, fairness, reduced number of call-drops while maximizing the throughput.

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List of Acronyms

3GPP	3rd Generation Partnership Project
4G	Fourth Generation
ABSF	Almost Blank Subframes
BLER	Block Error Rate
BW	Bandwidth
CC	Component Carrier
CDF	Cumulative Distribution Function
CDMA	Code Division Multiple Access
CQI	Channel Quality Indicator
CRE	Cell Range Expansion
CRS	Cell Specific Reference signal
DwPTS	Downlink Pilot Channel
eNB	evolved NodeB
EPS	Evolved Packet System
ExPF	Exponential Proportional Fairness
FAP	Femtocell Access Points
FDD	Frequency-Division Duplex
FFR	Fractional Frequency Reuse
FUE	Femtocell User
HARQ	Hybrid Automatic Repeat request
HeNB	Home eNodeB

HOL	Head of Line
HSPA	High-Speed Packet Access
ICI	Inter Cell Interference
ICIC	Inter Cell Interference Coordination
ISI	Inter-Symbol Interference
LTE	Long Term Evolution
MCS	Modulation and Coding Scheme
MLWDF	Maximum Largest Weighted Delay First
MME	Mobility Management Entity
MUE	Macrocell User
NCL	Neighbouring Cell List
NRT	Non-Real-Time service
OFDM	Orthogonal Frequency Division Multiplexing
OFDMA	Orthogonal Frequency Division Multiple Access
PAPR	Peak-to-Average Power Ratio
PDCCH	Physical Downlink Control Channel
PDSCH	Physical Downlink Shared Channel
PF	Proportional Fair
PUSCH	Physical Uplink Shared Channel
QAM	Quadrature Amplitude Modulation
QoS	Quality of Service
QPSK	Quadrature Phase Shift Keying

RB	Resource Block
RE	Resource Element
RNC	Radio Network Controller
RSRP	Reference Signal Received Power
RSS	Received Signal Strength
RT	Real-Time Service
SAE	System Architecture Evolution
SC-FDMA	Single Carrier Frequency Division Multiple Access
SFR	Soft Frequency Reuse
SFFR	Soft Fractional Frequency Reuse
S-GW	Serving GateWay
SINR	Signal to Interference and Noise Ratio
SON	Self-Organizing Networks
TB	Transport Blocks
TDD	Time-Division Duplex
TTI	Transmission Time Interval
TX	Transmitter
UpTS	Uplink Pilot Time Slot
UTRAN	UMTS Terrestrial Radio Access Network
WCDMA	Wide-band Code Division Multiple Access