Multi-Carrier Cooperative Wireless Communication

Performance Analysis and Resource Allocation

A thesis presented in partial fulfillment of the requirements for the degree of

Doctor of Philosophy
in
Electrical Engineering

at
Massey University, New Zealand.

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2013

ABSTRACT

Relay-based cooperative wireless communication is emerging as the major candidate technology for the next generation wireless cellular networks that will support significantly higher data rates than the recent systems. The combination of cooperative relaying with Orthogonal Frequency Division Multiplexing (OFDM) is a very promising design for next generation of wireless networks with increased system throughput and spectral efficiency. The success of this combination, like other wireless networks, relies on the efficient utilization of limited radio resources such as relays, power, subcarriers and antennas.

In this research, resource allocation problems are examined with different relaying techniques and protocols and computationally efficient resource allocation algorithms are proposed. The general objective is to device resource allocation schemes in relay-based cellular networks that maximize the system throughput under different constraints. The main goal of our research is to develop efficient resource allocation algorithms for two different relaying models, namely; one-way relaying and two-way relaying in realistic scenarios for the Third Generation Partnership Project (3GPP) Long Term Evolution Advanced (LTE-Advanced) cellular standard. Performance of the proposed algorithms will be evaluated in terms of not only the throughput but also the computational complexity. In particular, in this thesis we present low-complexity efficient schemes for jointly deciding the selection of relays and subcarriers for the users. Two types of fairness among users, namely; minimum rate proportional fairness and access proportional fairness, are also considered in assigning subcarriers to users in relay networks. A new low-complexity iterative resource block (RB)-pairing and allocation algorithm is also investigated in relay networks.

Finally, we present a brief analysis of inter-cell interference in relay networks. Both theoretical analysis and computer simulations are performed in the performance evaluation of the proposed algorithms. Furthermore, practical implementation issues are also addressed.

DEDICATION

To my **Mother**

(who will always be missed)

ACKNOWLEDGEMENT

First and foremost, all praises are due to Allah, who has given me strength, knowledge and patience to accomplish this work. Without His Blessings, Mercy and Grace, this dissertation would not have been possible.

I would like to thank my supervisors Dr. Xiang Gui and Dr. Amal Punchihewa for their guidance and support over the past years. Their expertise, understanding, and patience added considerably to my graduate experience. Through constant encouragement and invaluable advices, they helped me to develop as a researcher and an independent thinker.

I am grateful for the support and help of all my friends around the world. I would like to thank the Higher Education Commission (HEC) Pakistan for providing me the financial support of this work and my employer Bahauddin Zakariya University (BZU), Multan, Pakistan for giving me overseas study leave.

My deepest appreciations go out to my family members to whom I owe so much. I would like to thank my father and elder brother and sisters for the sacrifices they have made and for the inspiration and support, they provided throughout my life. I am blessed with my lovely wife, Tahira, whose love, patience, understanding and support made my doctoral journey come to this end. I would also like to thank someone very special to me: my children Rubab , Ahsan and Hassan for being the constant source of joy and happiness.

Finally, I would like to thank the staff of School of Engineering and Advanced Technology (SEAT) Massey University who assisted me whenever needed.

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LIST OF ABBREVIATIONS

AF	Amplify and Forward
ANC	Analogue Network Coding
APF	Access Proportional Fairness
AWGN	Additive White Gaussian Noise
BER	Bit Error Rate
BILP	Binary Integer Linear Programming
BS	Base Station
CSI	Channel State Information
DF	Decode and Forward
FRBP	Fixed Order RB-Pairing
HA	Hungarian Algorithm
ICI	Inter-Cell Interference
LB	Load Balancing
LOS	Line- Of-Sight
LTE	Long Term Evolution
MIMO	Multiple-Input Multiple-Output
MRC	Maximum Ratio Combining
MRPF	Minimum Rate Proportional Fairness
MRR	Minimum Rate Requirement
MSS	Maximum SNR Scheme
MT	Mobile Terminal
MUI	Multi-User Interference
NLOS	Non Line-Of-Sight
NP	Non-deterministic Polynomial-Time

OFDM	Orthogonal Frequency Division Multiplexing
OFDMA	Orthogonal Frequency Division Multiple Access
OWR	One-Way Relaying
PFS	Proportional Fairness Scheme
RB	Resource Block
RRS	Round robin Scheme
RT	Relay Terminal
SER	Symbol Error Rate
SINR	Signal-to-Interference-Noise Ratio
SNR	Signal to Noise Ratio
SRBP	Selective Order RB-Pairing
TDBC	Time Division Broadcast
TWR	Two-Way Relaying

NOTATIONS

Symbol	Definition
M	Number of Mobiles Terminals
R	Number of Relay Terminals
K	Number of Resource Blocks
$P_{x,m}^{k}$	Transmission Power of x to m^{th} MT on k^{th} RB
P_{T}^{k}	Total Transmission power for k^{th} RB
$h_{xy,m}^{k}$	Channel Gain form x to y for m^{th} MT on k^{th} RB
σ_{x}^{2}	Noise Power at x
g_{m}^{k}	Scaling/Amplification Factor for m^{th} MT on k^{th} RB
R_{x}	Instantaneous Throughput for x user over the k^{th} RB
γ	Signal to Noise Ratio/ Signal-to-Interference-Noise Ratio