

**SPECTRUM SHARING AND COEXISTENCE IN FUTURE
WIRELESS NETWORKS**

by
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ABSTRACT

With the spectrum resource in wireless networks becoming more congested, spectrum sharing is more crucial to meet the demands of future networks. With the increasing growth of mobile data traffic in the next-generation wireless communications system, capacity maximisation has been a central focus for government, academia and industry. Regulatory bodies have proposed different spectrum sharing techniques to solve the significantly increasing spectrum demand. There are two main spectrum sharing frameworks: Spectrum Access System (SAS) in the U.S. and Licensed Shared Access in Europe. Our work focuses on the SAS in the 3.5 GHz band. SAS is a three-tier spectrum sharing framework proposed by the Federal Communications Commission. The SAS three tiers are Incumbent Access, Priority Access Licensee (PAL) and General Authorised Access (GAA).

The optimal transmit power allocation problem is investigated for GAA users considering the transmission time fraction of GAA users in the SAS. To increase the capacity of GAA users, we consider the transmission time fraction of each GAA user for the transmit power and the channel allocation. Our proposed method finds the optimal channel switching schedule that maximises the average capacity of GAA users while satisfying the interference constraint at the PAL protection area and ensuring the fairness among GAA users.

We have proposed transmit power and channel allocation method that ensures conflict-free co-channel coexistence between PAL and GAA users as well as GAA users in different sets. We proposed the transmit power ad-

justment method using the information of the sets that can hear each other, which maximises the GAA users capacity. For a conflict-free resource allocation to the GAA users, a channel utilisation budget adjustment method is proposed considering GAA users in single and multiple sets.

Furthermore, mobile GAA users are considered in our study which adds an additional challenge to the resource allocation problem. We propose an interfering angle based method for the transmit power allocation for both fixed and mobile GAA users considering the interfering sets of users that are time-varying due to their mobility. Based on the information regarding the overlapping area, the maximum allowed transmit power is proposed for the interfering angle.

The coexistence among GAA users in SAS is a crucial problem to be solved to enhance the system capacity and to meet the increasing traffic demand. In summary, the resource allocation methods are presented in this thesis which contributes to interference protection and capacity maximisation in the Spectrum Access System.

CERTIFICATE OF ORIGINAL AUTHORSHIP

I, Shubhekshya Basnet declare that this thesis, is submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the School of Electrical and Data Engineering at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise reference or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

This document has not been submitted for qualifications at any other academic institution.

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To My Parents

Chitra Bahadur Basnet and Indira Basnet.

Contents

Abstract	iii
Acknowledgments	ix
Table of Contents	xiii
List of Figures	xvii
List of Tables	xxi
List of Publications	xxiii
1 Introduction	1
1.1 Background	2
1.1.1 5G and Future Wireless Networks Overview	2
1.1.2 Spectrum Sharing	4
1.2 Challenge and Motivation	6
1.3 Contributions	7
1.4 Organisation of the Thesis	11
1.5 Summary	12
2 Literature Review	13
2.1 Spectrum Sharing	14
2.1.1 Primary Users Detection Techniques	15

2.1.2	Interference Mitigation Techniques	16
2.1.3	Fairness	17
2.2	Cognitive Radio	18
2.3	Spectrum Sharing Frameworks	21
2.3.1	Licensed Shared Access	21
2.3.2	Spectrum Access System	23
2.4	Vehicular Communications	29
2.5	Summary	31
3	Coexistence between Priority Access Licensees and General Au-	
	thorised Access Users in Spectrum Access System	33
3.1	Introduction	34
3.2	System Model	35
3.3	Opportunistic Access to PAL Channel for GAA User Transmission in	
	SAS	38
3.3.1	Average Aggregate Interference	40
3.3.2	GAA Users Transmit Power and Transmission Time Fraction	
	Allocation Considering Single PAL Channel	40
3.4	Considering Switching Overhead for Transmit Power Allocation for	
	GAA User in Spectrum Access System	41
3.4.1	Switching Overhead	42
3.4.2	GAA Users Transmit Power and Transmission Time Fraction	
	Allocation Considering Multiple PAL Channels	43
3.5	Fairness Aware Resource Allocation for General Authorized Access	
	Users	45
3.5.1	Carrier Sensing Range	45
3.5.2	GAA Users Transmit Power and Transmission Time Fraction	
	Allocation Considering Fairness	46
3.6	Numerical Results	49

3.6.1	Numerical Results Considering Single PAL Channel	50
3.6.2	Numerical Results Considering Multiple PAL Channels	52
3.6.3	Numerical Results Considering Fairness between GAA Users	56
3.7	Summary	59
4	Interference Aware Resource Allocation Scheme for General Au-	
	thorised Access Users	63
4.1	Introduction	63
4.1.1	Related Works	64
4.2	System Model	67
4.3	Problem Formulation	68
4.3.1	Channel Utilisation Budget for GAA Users that Belong to a Single Set and Multiple Sets	70
4.3.2	PAL Users Protection from Multiple GAA Users	72
4.3.3	GAA Users Channel Assignment Condition	74
4.3.4	Conflict-free Channel Allocation for GAA Users	74
4.3.5	Resource Allocation for GAA Users	75
4.3.6	Transmit Power Allocation for GAA Users	76
4.3.7	Channel Allocation for GAA Users	79
4.3.8	GAA Users Resource Allocation Algorithm	80
4.4	Numerical Results	80
4.5	Summary	90
5	Conflict-free Resource Allocation to Fixed and Mobile GAA Users	93
5.1	Introduction	93
5.1.1	Related Works	94
5.2	System Model	96
5.3	Resource Allocation for FGAA Users and MGAA Users	98

5.3.1	Interfering Angle Based Maximum Allowed FGAA Transmit Power Constraint	100
5.3.2	Interference Protection to PAL Users	102
5.3.3	Self Coexistence Between GAA Users Constraint	103
5.3.4	Interfering Angle Based Resource Allocation	105
5.4	Numerical Results	110
5.5	Summary	117
6	Conclusion	119
6.1	Remarks	119
6.2	Future Work	121
	Abbreviations	123

List of Figures

1.1	Global mobile data traffic growth [1]	2
1.2	Future networks objectives and design goal [14]	3
1.3	Radio frequency spectrum band [5]	4
2.1	Sub-problems for the resource allocation problem and challenges	20
2.2	LSA architecture	22
2.3	Three tier access in the 3.5 GHz band	23
2.4	SAS architecture [7]	25
2.5	3.5 GHz band plan	25
2.6	Emissions and interference limits [10]	26
3.1	PAL and GAA users in a census tract	36
3.2	Illustration of channel switch for GAA users	42
3.3	Transmit power of GAA users with different transmission time fractions and particular locations, results of convex optimisation for transmit power allocation when transmission time fraction is known	50
3.4	Downlink capacity of GAA users	51
3.5	Transmit power allocation for GAA users with average and instantaneous aggregate interference with transmission time fraction $\mu_i = 1/ \mathcal{N} $	52
3.6	Transmit power allocation for GAA users from equation (3.14) and when $\mu_i = 1/ \mathcal{N} $	53

3.7	Transmission time fraction allocation for GAA users, results of convex optimisation from equation (3.14)	54
3.8	Transmit power allocation of GAA users at PAL1 channel with and without PAL1 transmission	54
3.9	Instantaneous aggregate interference at PAL1 user	55
3.10	Instantaneous aggregate interference at PAL2 user	55
3.11	Average downlink capacity of GAA users	56
3.12	GAA users transmission time fraction threshold at different PAL channels	57
3.13	Transmit power of GAA users from the proposed method and equal time allocation scheme [77]	58
3.14	Interference from GAA users to PAL users	59
3.15	Average capacity of GAA users at different PAL channels.	59
3.16	JFI score for $I_{RMS,m,j}^l$ and $\mu_{m,l}^{\hat{k}}$ at different PAL channel for different sets of GAA users	60
4.1	Multiple PAL and multiple GAA users in different sets in a census tract.	67
4.2	RMS interference from multiple GAA users to the PAL user protection area	72
4.3	GAA users in multiple sets	74
4.4	RMS interference at the PAL users protection area from the GAA users	82
4.5	CDF of channel utilisation budget from our proposed adjustment method using similar method as in [109].	83
4.6	CDF of transmit power allocation for 15 GAA users for the different number of PAL users in a single channel.	84
4.7	CDF of instantaneous aggregate interference for 15 GAA users for the different number of PAL users.	85

4.8	CDF of average GAA users capacity from optimisation equation (4.25) and our proposed sub-optimal method	86
4.9	CDF of transmit power allocation for GAA users in a single set and multiple sets from our proposed method	86
4.10	CDF of transmit power allocation comparison between [86] and our proposed method.	87
4.11	CDF of transmit power increment for different numbers of GAA Users	87
4.12	Average GAA network capacity increment from our proposed channel and transmit power allocation method compared to [86] and [97] . . .	88
4.13	Average capacity comparison from transmit power allocation done first followed with channel allocation and vice-versa	88
5.1	Illustration of PAL, FGAA, MGAA users interference scenarios in a census tract	95
5.2	Impact of MGAA users interference to FGAA users a) MGAA users and FGAA users cannot hear each other, but user equipment in overlapped area are interfered b) MGAA users and FGAA users can hear each other, i.e. they are within the carrier sensing range c) MGAA user and FGAA user do not interfere with each other.	98
5.3	Illustration of FGAA user and MGAA user with overlapped area, and PAL user protection area to find the RMS interference from GAA users at point K_i	102
5.4	Average GAA users capacity considering MGAA users with different speed compared to [100]	112
5.5	Comparison of our proposed method with optimal for the test case with 2 FGAA and 1 MGAA users	113
5.6	RMS interference from GAA user to multiple PAL users protection area allocated to the same PAL channel	114

5.7 RMS interference at PAL user protection area from our proposed method and [102] 114

5.8 Transmit power allocation of GAA users with different number of PAL users in the same channel 115

5.9 Interfering angles for different number of GAA Users 115

5.10 Transmit power with and without considering the conflicts 116

List of Tables

2.1	Transmission Opportunity in Different Dimensions	14
2.2	Summary of Interference Mitigation Techniques	17
3.1	Table of Notation and Description	37
4.1	Table of Notation and Meaning	66
4.2	The Channel Allocation for GAA Users	89
5.1	Symbols and Definitions.	97

List of Publications

Journal publications

- S. Basnet, Y. He, E. Dutkiewicz and B. A. Jayawickrama, “Resource Allocation in Moving and Fixed General Authorized Access Users in Spectrum Access System,” *IEEE Access*, vol. 7, pp. 107863-107873, 2019. (Corresponding to Chapter 5)

Conference publications

- S. Basnet, B. A. Jayawickrama, Y. He, E. Dutkiewicz and M. D. Mueck, “Opportunistic Access to PAL Channel for Multi-RAT GAA Transmission in Spectrum Access System,” *2017 IEEE 85th Vehicular Technology Conference (VTC Spring)*, Sydney, NSW, 2017, pp. 1-5. (Corresponding to Chapter 3)
- S. Basnet, B. A. Jayawickrama, Y. He and E. Dutkiewicz, “Considering switching overhead for transmit power allocation for GAA in spectrum access system,” *2017 17th International Symposium on Communications and Information Technologies (ISCIT)*, Cairns, QLD, 2017, pp. 1-5. (Corresponding to Chapter 3)
- S. Basnet, B. A. Jayawickrama, Y. He and E. Dutkiewicz, “Transmit Power Allocation for General Authorized Access in Spectrum Access System Using

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- S. Basnet, B. A. Jayawickrama, Y. He and E. Dutkiewicz, “Fairness Aware Resource Allocation for Average Capacity Maximisation in General Authorized Access User,” *2018 IEEE 88th Vehicular Technology Conference (VTC-Fall)*, Chicago, IL, USA, 2018, pp. 1-5. (Corresponding to Chapter 3)