



## Scientific Report

First name / Family name

M. Majid Butt

Nationality

Pakistani

Name of the *Host Organisation*

University of Luxembourg

First Name / family name  
of the *Scientific Coordinator*

Prof. Bjorn Ottersten

Period of the fellowship

015/06/2012 to 14/06/2013



## I – SCIENTIFIC ACTIVITY DURING YOUR FELLOWSHIP

Cognitive radio is a promising area of research and has the potential of providing improved utilization of spectral resources. Interdisciplinary Centre for Security, Trust and Reliability (SnT) is very active in the area of Satellite communication. I contributed to the team's research activity on cognitive radio where there are several on-going projects and PhD candidates pursuing their thesis work.

I worked on the project cognitive radios for Satellite communications with postdocs Symeon Chatzinotas and Dzevdan Kapetanovic and Prof. Bjorn Ottersten. The focus of my research is to explore different underlay, overlay and interweave cognitive radio techniques in relation to the Satellite networks. We investigate the signal processing and resource allocation aspects of the cognitive radio for the various scenarios. I contributed to the following tasks for the project:

1. Review of standardization activities in the area of cognitive radios
2. Literature review for Non-European projects on cognitive radios
3. Literature review for underlay cognitive radio communication techniques
4. Research on resource allocation schemes for underlay and interweave cognitive communications and published results.

We worked on radio resource allocation schemes for multiple access cellular networks as well. Specifically, we worked on the following problems:

- Maximization of system throughput for minimum (per user) throughput guarantees. The main contribution is the proposal of a novel scheme which gives promising results as compared to state of the art techniques for finite (averaging) window case. The results published in IEEE Wireless Communication letter.
- Minimization of system energy for the multiple access system with the bounds on average packet dropping rate and maximum number of packets dropped successively. The proposed scheme uses cross layer techniques and the scheme is analyzed using Markov chain analysis and large system results. The results published in Proc. of IEEE PIMRC.

## II – PUBLICATION(S) DURING YOUR FELLOWSHIP

1. **M. Majid Butt**, Eduard A Jorswieck, "Maximizing System Energy Efficiency by Exploiting Multiuser Diversity and Loss Tolerance of the Applications", IEEE trans. Wireless Communications vol. 12, no. 9, pp. 4392-4401.
2. **M. Majid Butt**, Dzevdan Kapetanovic, Bjorn Ottersten, "Maximizing Minimum Throughput Guarantees: The Small Violation Probability Region", *IEEE Wireless Communication Letters*, vol. 2, no. 3, pp 271-274, June, 2013.
3. **M. Majid Butt**, Eduard A. Jorswieck and Bjorn Ottersten, "Maximizing Energy Efficiency for Loss Tolerant Applications: The Packet Buffering Case", in Proc. *IEEE International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC)*, London, UK, September 2013.
4. Dzevdan Kapetanovic, **M. Majid Butt**, Symeon Chatzinotas, Björn Ottersten,



"Secondary Users Scheduling Under Throughput Guarantees for the Primary Network", in Proc. *International Workshop on Wideband Mobile Cognitive Radio Communications and Networks in conjunction with VTC-2013-fall*, Las Vegas, USA, September 2013.

5. Guidotti, Loredana Arienzo, **M. Majid Butt**, Laurent Combelles, Symeon Chatzinotas, Nicolas Chuberre, Barry Evans, Thibault Gallet, Joel Grotz, Dzevdan Kapetanovic, Konstantinos Liolis, Miguel López-Benítez, Shree Krishna Sharma, Gerald Schlueter, Daniele Tarchi, Alessandro Vanelli-Coralli, "Cognitive Radios in SatComs: Business, Regulatory, Standardisation, and Technological Drivers", accepted for publication in *31st AIAA International Communication Satellite Systems Conference*, Florence, Italy, October 2013.
6. **M. Majid Butt** and Eduard A. Jorswieck, "Energy Efficient Multiuser Scheduling: Exploiting the Loss Tolerance of the Application", in Proc. of *Global Communication Conference (Globecom)*, Anaheim, CA, USA, December, 2012.

### III – ATTENDED SEMINARS, WORKHOPS, CONFERENCES

1. Attended *IEEE International Workshop on Signal Processing advances in Wireless Communications (SPAWC)* in Cesme, Turkey in June, 2012 and presented my accepted paper.
2. Attended *Global Communication Conference (Globecom)* in Anaheim, CA, USA, in December, 2012 for my accepted paper.

### IV – RESEARCH EXCHANGE PROGRAMME (REP)

N/A