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Energy-efficient Radio Resource Management in Future Networks

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ISCTE-IUL, Av. das Forças Armadas, Lisboa, Sala C202

You are invited to participate in this joint event of IEEE ComSoc, IMS and VTS Chapters on Energy-efficient Radio Resource Management in Future Networks:

First talk: *Traffic and energy load balancing in cooperative dual-powered green cellular networks*

Second Talk: *Energy- and Spectral-Efficient Resource Allocation Algorithm for Heterogeneous Networks*

Date and Time

Location


Hosts

Registration

Date: **30 Nov 2022**

Time: **02:00 PM to 04:30 PM**

All times are (UTC+00:00) Lisbon

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ISCTE-IUL, Av. das Forças Armadas

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Luís Bernardo, lflb@fct.unl.pt

Daniel Corujo, dcorujo@av.it.pt

Co-sponsored by Instituto de Telecomunicações

[Link to External Registration](#)

Speakers

[Swades De of Indian Institute of Technology Delhi](#)

Topic: Traffic and energy load balancing in cooperative dual-powered green cellular networks

Power consumption in cellular wireless communication base stations is a significant cost factor for the service providers. Further, it significantly adds to the global carbon footprint. To this end, ambient-powered wireless base stations are being explored. In this presentation, we will present the case of networked cellular base stations that are equipped with solar/ambient energy harvesting capability as well as they are connected to the power grid for their uninterrupted operation. Since the ambient energy availability as well as cell traffic are stochastic processes, we demonstrate the need for inter-base station cooperation for dealing with this doubly-stochastic processes at potentially reduced grid power consumption cost. Under such inter-base station cooperative scenario, we investigate the energy harvesting and storage capacity and operation optimization strategies for operator revenue maximization and/or green cellular operation.

Beyond the CAPEX optimization, implementation of the proposed strategies require only software

intervention at the Radio Network Controller or Remote Radio Units.

Biography:

Dr. Swades De is a full professor with the Department of Electrical Engineering and an Institute Chair Professor at Indian Institute of Technology Delhi. Dr. De's research interests are broadly in communication networks, with emphasis on performance modeling and analysis. Current directions include energy harvesting communication networks, broadband wireless access and routing, network coexistence, smart grid networks, and smart IoT. To date, he has published over 230 articles in top journals and well-known conferences, a few book chapters, an edited book, 1 US/EU/WO patent, and filed 9 Indian patents and 6 US/EU/World patents.

Prof. De currently serves as an Area Editor for IEEE Communications Letters, Area Editor for Elsevier Computer Communication, Associate Editor for IEEE Transactions on Vehicular Technology, IEEE Wireless Communications Letters, and IEEE Wireless Communications Magazine. Prof.

De is a Fellow of Indian National Academy of Engineering, Fellow of National Academy of Sciences, India, Fellow of The Institute of Engineers, India, and Fellow of IET, UK.

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[Ender Ayanoglu of University of California Irvine](#)

Topic: Energy- and Spectral-Efficient Resource Allocation Algorithm for Heterogeneous Networks



In this talk, the tradeoff between energy efficiency and spectral efficiency in multicell heterogeneous networks is investigated. Our objective is to maximize both energy efficiency and spectral efficiency of the network, while satisfying the minimum rate requirements of the users. We define our objective function as the weighted summation of energy efficiency and spectral efficiency functions. The fractional frequency reuse (FFR) scheme is employed to suppress intercell interference. We formulate the problem as cell-center boundary selection for FFR, frequency assignment to users, and power allocation. The optimal solution of this problem requires exhaustive search over all cell-center radii, frequency assignments, and power levels. We propose a three-stage algorithm and apply it consecutively until convergence. First, we select the cell-center radius for the FFR method. Second, we assign the frequency resources to users to satisfy their rate requirements and also maximize the objective function. Third, we solve the power allocation subproblem by using the Levenberg-Marquardt method. Minimum rate requirements of

users are also included in the solution by using dual decomposition techniques. Our numerical results show a Pareto-optimal solution for energy efficiency and spectral efficiency. We present energy efficiency, spectral efficiency, outage probability, and average transmit power results for different minimum rate constraints. Among other results, we show that, in a particular setting, 13% energy efficiency increase can be obtained in a multicell heterogeneous wireless network by sacrificing 7% spectral efficiency.

Biography:

Ender Ayanoglu received the Ph.D. degree from Stanford University, Stanford, CA in 1986, in electrical engineering. He was with the Communications Systems Research Laboratory, part of AT&T Bell Laboratories, Holmdel, NJ until 1996, and Bell Labs, Lucent Technologies until 1999. From 1999 until 2002, he was a Systems Architect at Cisco Systems, Inc., San Jose, CA. Since 2002, he has been a Professor in the Department of Electrical Engineering and Computer Science, University of California, Irvine, Irvine, CA, where he served as the Director of the Center for Pervasive Communications

and Computing and held the Conexant-Broadcom Endowed Chair during 2002-2010. His past accomplishments include invention of the 56K modems, characterization of wavelength conversion gain in Wavelength Division Multiplexed (WDM) systems, and diversity coding, a technique for link failure recovery in communication networks employing erasure coding introduced in 1990, prior to the publication of the first papers on network coding. During 2000-2001, he served as the founding chair of the IEEE-ISTO Broadband Wireless Internet Forum (BWIF), an industry standards organization which developed and built a broadband wireless system employing Orthogonal Frequency Division Multiplexing (OFDM) and a Medium Access Control (MAC) algorithm that provides Quality-of-Service (QoS) guarantees. This system is the precursor of today's Fourth and Fifth Generation (4G and 5G) cellular wireless systems. From 1993 until 2014, Dr. Ayanoglu was an Editor, and since January 2014 is a Senior Editor of the IEEE Transactions on Communications. He served as the Editor-in-Chief of the IEEE Transactions on Communications from 2004 to 2008. From January 2015 until December 2016 he served as the Editor-in-Chief of the IEEE Journal on Selected Areas in Communications - Series on Green Communications and Networking. This series published three special issues with record number of papers. He led the efforts to start the IEEE Transactions on Green Communications and Networking and served as its Founding Editor-in-Chief from August 2016 to August 2020. From 1990 to 2002, he served on the Executive Committee of the IEEE Communications Society Communication Theory Committee, and from 1999 to 2002, was its Chair. Dr. Ayanoglu is the recipient of the IEEE Communications Society Stephen O. Rice Prize Paper Award in 1995, the IEEE Communications Society Best Tutorial Paper Award in 1997, and the IEEE Communications Society Communication Theory Technical Committee Outstanding Service Award in 2014. He has been an IEEE Fellow since 1998.

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Agenda

2:00 pm Prof. Swades De, Indian Institute of Technology Delhi, "Traffic and energy load balancing in cooperative dual-powered green cellular networks"

3:10 pm coffee-break

3:30pm Prof. Ender Ayanoglu, University of California Irvine, "Energy- and Spectral-Efficient Resource Allocation Algorithm for Heterogeneous Networks"

The event is co-sponsored by Instituto de Telecomunicações

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