

Tutorial T16: Radio Resource and Interference Management in 5G Cellular Networks: A Tutorial

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Tutorial Overview

This tutorial will delve into the radio resource and interference management (RRIM) problem in 5G cellular networks. Starting with the visions and requirements for 5G multi-tier cellular networks (in terms of data rate, latency, cost and energy), the corresponding key enabling technologies for increasing energy bandwidth, spectral efficiency, and extreme densification and offloading are discussed, followed by a discussion on the challenges of radio resource and interference management (e.g., power control, channel allocation, user association) raised by these enabling technology in 5G cellular networks, specially in co-channel deployment scenarios. Open research issues and possible approaches to tackle those challenges will be described. Also, a taxonomy of the related literature addressing the different aspects of the RRIM problem will be provided highlighting the different methodologies adopted for analysis and optimization of RRIM in 5G multi-tier cellular networks.

Part 1 (Introduction): Visions and requirements for 5G cellular networks, key enabling technologies in 5G cellular networks, RRIM challenges in 5G cellular networks (Modeling interference in 5G networks and capacity analysis, channel partitioning, channel allocation, and frequency reuse in multi-tier networks, cell association, power control and admission control, in-band full duplex communication, RRIM under backhaul-constraints, inter-tier network MIMO, cognitive/self-organizing RRIM)

Part 2 (Channel allocation and interference management): Inter-cell interference coordination (ICIC) and frequency reuse, static ICIC and dynamic ICIC, enhanced frequency reuse with power control, carrier aggregation-based cross-tier interference management, stochastic geometry-based modeling

Part 3 (Cell association): Reference signal received power (RSRP)-based user association, bias-based cell range expansion (CRE), almost blank sub-frame (ABS) ratio, hybrid channel, load, and scheduling criteria-aware user association, multi-cell and multi-RAT association, coupled and decoupled user association

Part 4 (Power and admission control in multi-tier cellular networks): Closed-loop and open-loop power control, target-SINR tracking power control algorithm (TPC), opportunistic power control algorithm (OPC), dynamic target-SINR tracking power control algorithms (DTPC), joint power and admission control, protection constraints for prioritized users and joint power and admission control (JPAC) algorithms, characterization of feasible interference region

Part 5 (RRIM in FD and D2D networks): In-band full duplexing, self interference, and spectral efficiency, power control for in-band full-duplex small cell networks, duplex-mode selection for small cells with wireless backhauling, mode and channel selection for D2D communications, joint power control and channel allocation for relay-assisted D2D communication

Presenter Biographies

Ekram Hossain (IEEE Fellow) is currently a Full Professor in the Department of Electrical and Computer Engineering at University of Manitoba, Winnipeg, Canada. His current research interests include resource allocation and medium access control in wireless networks, cooperative and cognitive wireless systems, and green radio communications. He is an author/editor of the books *Wireless Device-to-Device Communications and Networks* (Cambridge University Press, 2015), *Radio Resource Management in Multi-tier Cellular Wireless Networks* (Wiley, 2013), *Smart Grid Communications and Networking* (Cambridge University Press, 2012), *Cooperative Cellular Wireless Networks* (Cambridge University Press, 2011), *Dynamic Spectrum Access and Management in Cognitive Radio Networks* (Cambridge University Press, 2009), *Cognitive Wireless Communication Networks* (Springer, 2007), *Wireless Mesh Networks: Architectures and Protocols* (Springer, 2007), *Introduction to Network Simulator NS2* (Springer, 2008), *Heterogeneous Wireless Access Networks* (Springer, 2008). Dr. Hossain served as the Area Editor for the *IEEE Transactions on Wireless Communications* (2009-2011) and an Editor for the *IEEE Transactions on Mobile Computing* (2007-2012). Also, he was a Distinguished Lecturer of the IEEE Communications Society (2012-2015). Currently, he serves as the Editor-in-Chief for the *IEEE Communications Surveys and Tutorials* and an Editor for *IEEE Wireless Communications*. Also, he is a member of the IEEE Press Editorial Board. He presented tutorials on different emerging wireless communications technologies in the IEEE conferences including ICC'14, ICC'13, ICC'12, Globecom'11, PIMRC'11, ICC'10, ICC'09, VTC'08-Fall, Globecom'07, and WCNC'07.

Mehdi Rasti is an Assistant Professor at the Department of Computer Engineering and Information Technology, Amirkabir University of Technology, Tehran, Iran. He received his Ph.D. degree from Tarbiat Modares University, Tehran, Iran, in Electrical Engineering in 2009. From November 2007 to November 2008, he was a visiting researcher at the Wireless@KTH, Royal Institute of Technology, Stockholm, Sweden. From June 2013 to August 2013, and from July 2014 to August 2014 he was a visiting researcher in the Department of Electrical and Computer Engineering, University of Manitoba, Canada. His current research interests include interference and radio resource management in wireless networks, cognitive radio networks, and heterogeneous cellular networks. He has published a number of journal papers in *IEEE Transactions on Information Theory*, *IEEE Transactions on Wireless Communications*, *IEEE Transactions on Communications*, *IEEE Transactions on Vehicular Technology*, and *IEEE Transactions on Mobile Computing*, during last five years. He co-authored a paper on evolution toward 5G multi-tier cellular wireless networks which has been one among the top 10 articles published in *ComSoc* periodicals viewed online, based on PDF views through IEEE Xplore (November and July 2014).