

Preface

This volume addresses the concept of radio resource allocation for cellular communications systems operating in congested and contested environments with an emphasis on end-to-end quality of service (QoS). The radio resource allocation is cast under a proportional fairness formulation which translates to a convex optimization problem. Moreover, the resource allocation scheme considers subscription-based and traffic differentiation in order to meet the QoS requirements of the applications running on the user equipments (UEs) in the system. The devised resource allocation scheme is realized through a centralized and distributed architecture and solution algorithms for the aforementioned architectures is derived and implemented in the mobile devices and the base stations. The sensitivity of the resource allocation scheme to the temporal dynamics of the quantity of the users in the system is investigated. Furthermore, the sensitivity of the resource allocation scheme to the temporal dynamics in the application usage percentages is accounted for. In addition, a transmission overhead of the centralized and distributed architectures for the resource allocation schemes is performed. Furthermore, the resource allocation scheme is modified to account for a possible additive bandwidth done through spectrum sharing in congested and contested environments, in particular spectrally coexistent radar systems. The radar-spectrum additive portion is devised in a way to ensure fairness of the allocation, high bandwidth utilization, and interference avoidance. In order to justify the aforesaid modification, the interference from radar systems into the Long-Term Evolution (LTE) as the predominant 4G technology is studied to confirm the possibility of the spectrum sharing. The preceding interference analysis contains a detailed simulation of radar systems, propagation path loss models, and a third generation partnership project compliant LTE system. The propagation models are Free Space Path Loss (FSPL) and Irregular Terrain Model (ITM). The LTE systems under consideration are macro cell, outdoor small cells, and indoor small cells. In order to consider the QoS on an end-to-end basis, a delay-based modeling of the backhaul network, as the

bottleneck in modern cellular communications systems, is presented. The modeling task is fine-grained through an optimum selection from a variety of candidate hidden Markov models and vector quantization schemes. A model-based signature statistical analysis is performed to evaluate the modeling fidelity.

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