Editorial

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Biographical notes: Jie Zhang is a Professor of Wireless Communications and Networks in the Department of Computing and Information Systems, University of Bedfordshire (UoB), UK. He received his PhD from East China University of Science and Technology, Shanghai, China, in 1995. From 1997 to 2002, he was with the Department of Electronic and Electrical Engineering, University College London, the Department of Engineering Science, Oxford University and Aircom. As the Principal Investigator, currently he is responsible for some £1.3 million (US$2.5 million) research funding in the areas of wireless communications and networks. He is a Member of the IET and IEEE.

Wireless networks such as 3G/4G and WLAN/WMAN play an important role for broadband communications and ubiquitous computing infrastructure. In future, a large portion of the access network will go wireless.

In order to satisfy the requirements on coverage, capacity and Quality of Service (QoS) and to reduce the infrastructure cost, both 3G/4G and WLANs/WMANs need careful planning and optimisation. A modern wireless network can neither be successfully deployed, nor be successfully expanded without proper planning, whilst in operation, a wireless access network undergoes frequent reoptimisation phases according to changing demands and new business models.

The planning and optimisation of wireless access networks is very complicated and faces many challenges. Traditional planning methods require experienced planners to manually select and configure network elements. As there are many network elements with many parameters to configure, it is very unlikely that one can find the optimal network configuration using a manual method. Approaches and tools that can automate wireless network planning and optimisation are urgently needed by the mobile communications industry.

All the papers submitted to this Special Issue were reviewed by the experts in this field and eight were selected for publication at IJMNDI. The selected papers cover simulation, planning and optimisation of 3G, B3G, WLAN and heterogeneous wireless access networks.

The first two papers are on WLAN planning and optimisation.

The paper by G. de la Roche, K. Jaffres-Runser and J-M. Gorce and titled 'On predicting in-building WiFi coverage with a fast discrete approach', presents a new approach for predicting coverage of WLAN at 2.4 GHz. Fast and accurate path loss calculation is central to planning and optimisation of any infrastructure based wireless networks, in particular, for the coverage prediction of indoor WLANs. Multi-Resolution Frequency Domain ParFlow (MR-FDPF) approach, which is a Transmission Line Matrix (TLM) method, is used in this paper to balance the computational load and the accuracy of propagation calculation. In the first part, this paper presents the straight lines of MR-FDPF and details the conditions for efficient in-building coverage prediction at 2.4 GHz. In the second part, this paper tackles the calibration problem and proposes an automatic calibration process to improve the matches between predictions and measurements. Finally, some experiments are carried out to verify the accuracy of the proposed method.

The paper by A. Gondran and A. Caminada, J. Fondrevelle and O. Baala and titled 'Wireless LAN planning: a didactical model to optimise the cost and effective payback', describes a set of formal models that can be used to plan cost effective large-scale WLANs. The Access Point (AP) location and pattern, the antenna orientation, the emitted power and the antenna frequency channel are included in this model. Automatic Cell Planning (ACP) and Automatic Frequency Planning (AFP) are considered together. With the formal model description, this paper illustrates step by step the process of WLAN planning from the AP location to the effective throughput computation. Examples are given at each section to didactically emphasise the planning problem and the model defined.

The following four papers relate to the planning and optimisation of 3G and beyond wireless systems, in particular, WCDMA networks.

The paper by J. Yang, J. Zhang, M.E. Aydin and J.Y. Wu and titled 'Optimisation of WCDMA radio networks with consideration of link-level performance factors', investigates methods to balance the accuracy and the computational load in WCDMA radio network planning and optimisation. Link-level performance factors such as the impacts of soft handover and fast power control are considered in system-level simulations to obtain a good trade-off between accuracy and the computational load. A mixed integer-programming model is proposed by the authors and optimisation strategies based on two meta-heuristics, namely Tabu Search (TS) and Simulated Annealing (SA) are studied. In addition,

experiments are carried out to compare the performance of the heuristic algorithms with respect to the solution quality and the level of robustness.

The paper by A. Formella, F. Aguado-Agelet, L. Mendo and J.M. Hernando and titled 'Site selecting algorithms for nodes B', presents two UMTS site selecting algorithms. The algorithms take into account propagation predictions as well as the traffic distribution in the target area, considering multiple service classes, transmit power constraints and quality requirements, both in uplink and downlink. For a traffic distribution sample, the proposed algorithms, that is, heuristic backtracking algorithm and genetic algorithm, find the minimum number of Nodes B needed to provide the demanded capacity or a low number of nodes according to heuristic criteria.

The paper by A. Wiedemann and titled 'Processing capacity planning and optimisation of UMTS and beyond radio access network architectures by simulation', presents an event-driven and tool-based simulation methodology which provides decision support to the network designer for 3G/B3G cellular networks. The proposed methodology will enable network designers to assess 3G/B3G Radio Access Networks (RANs) with regard to signalling performance and to compare them with the UMTS RAN Release 99 (R99) reference architecture in a very early design phase. Moreover, the network designer can modify the capacity allocation to processors and estimate the overall processing capacity demand. A case study on processor capacity planning and End-to-End (E2E) signalling performance optimisation of a conceivable RAN evolution scenario is also provided within this paper.

The paper by P. Lahdekorpi, J. Niemela and J. Lempiainen and titled 'Effect of repeaters on the performance in WCDMA networks', studies the impact of repeaters on WCDMA system performance. Repeaters have been traditionally used in cellular mobile communication networks for temporary coverage extensions. Deployment of repeaters in capacity-limited scenarios requires more careful radio network planning compared to the traditional approach for operation in coverage-limited environment. In this paper, system level simulations are conducted first, which are then verified by actual field measurement data. The results of the simulations and field measurements reveal that a proper configuration of a repeater can provide a significant downlink capacity gain, which indicates that the repeaters are also useful in capacity-limited environments. In addition, the obtained outcomes show that repeaters can effectively improve cell dominance in pilot polluted areas, which has direct impacts on soft handover probabilities in the network. Finally, this paper shows utilisation of repeaters might also improve the performance of the whole network by also improving the uplink direction.

The last two papers relate to heterogeneous wireless access networks. It is expected that in the future, different wireless access technologies will coexist. Therefore, the study on the issues related to the planning and optimisation of heterogeneous wireless access networks is timely and important.

The paper by K. Johansson, J. Zander and A. Furuskar and titled 'Modelling the cost of heterogeneous wireless access networks', presents a costing model for heterogeneous wireless access networks. As it is expected that future wireless access to the internet will be facilitated by 'multiradio' (e.g. using SDR techniques) user terminals that allow for automatic selection between available access methods, the cost model for heterogeneous wireless access networks is an important subject of study. In this paper, the authors propose a methodology for analysing the cost and capacity of both single-access (including hierarchical cell structures) and multiaccess networks. With some numerical examples, including packet data optimised evolutions of 3G such as HSDPA, 3G Long Term Evolution (LTE) and IEEE 802.11a WLAN, the authors demonstrate how the model can be used to evaluate the average total cost of a heterogeneous network dimensioned for a non-uniform spatial traffic distribution. The research outcomes can be used by researchers and decision makers as a means to quantify the cost and economics of heterogeneous wireless access networks.

The final paper by K. Yang, Y. Wu, Y. Yang and E. Liu and titled 'Policy-based service-driven dynamic planning of heterogeneous wireless networks', presents a very interesting approach for dynamic network planning. Such an approach is novel and is important for heterogeneous wireless networks in providing adaptive and cost-effective services to the users. Based on the analysis of the basic architecture of future heterogeneous wireless networks and their implications on dynamic network planning, a policy-based service-driven approach is proposed and its prototype implemented by the authors in this paper. The proposed approach especially advocates the context-aware adaptability of network planning via policy-based management method and the service-driven nature of dynamic network planning.

The guest editor hopes the readers will find the selected papers stimulating and interesting and looks forward to developing this important research area with other researchers in the wireless communications communities (both academia and industry).