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Foreword

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The year 2020 saw the commercial opening of fifth generation mobile phone networks. Since the 1990s, generations of mobile networks have followed one another every 10 years. The second generation, GSM, has democratized access to wireless mobile telephony. For the first time it was possible to be far from home while remaining close to family. The third generation in the 2000s and then 4G in the 2010s enabled mobile Internet access, first at moderate speed then at high/very high speed. These generations had in common that they had the human person at the center of uses. With 5G, wireless networks will have been designed for the first time from the outset with the aim of making possible both person-to-person, person-to-machine and machine-to-machine communications, giving potential access to a plethora of data-based services. The studies that have enabled the deployment of 5G are opening up new challenges. The technological developments specific to this generation, the frequency rise, the foreseeable evolutions that will require going beyond the framework of 5G towards the next generation, will continue to stimulate significant efforts and new lines of research, involving the academic world and industry. The deployment of this new generation also raises many societal questions linked on the one hand to the energy consumption of 5G and on the other to electromagnetic waves and associated exposure. The question of possible health impacts has given rise to numerous debates where the perception of risk has been favored at the expense of an objective assessment of the risk and of the actual exposure.

In view of all these challenges, opportunities and questions, URSI France decided in 2019 to organize its 2020 annual scientific workshop on the theme of "Networks of the future: 5G and beyond", on the campus of Telecom Paris (Institut Polytechnique de Paris), Palaiseau, March 11–13, 2020.

This special issue is organized in 8 papers covering different aspects and challenges of future networks. The first papers deal with the exposure induced by 5G system.

The paper entitled "*In-situ* evaluation of exposure induced by 5G antennas in the 3.4–3.8 GHz band" is written by E. Conil and J. B. Agnani. It describes exposure measurements performed in the vicinity of four pilot sites. The authors point out variations in the levels of exposure depending on use of network resources and they propose a new indicator of exposure.

The second one, "Numerical modeling of downlink electromagnetic wave exposure generated by 5G beamforming antennas", authored by N. Noé and F. Gaudaire, analyses scenarios used for numerical modeling of electromagnetic wave exposure to beamforming antennas. The authors underline the influence of the environment around the antennas on the distribution of the electric field.

The third paper, entitled “On the Measurement Procedures for the Assessment of the Specific Absorption Rate (SAR) from MIMO Cellular-Equipment of Fast Varying Relative Phases”, is authored by M. Teniou, M. Ramdani, O. Jawad, T. Julien, S. Pannetrat and L. Aberbour. This paper introduces a measurement methodology for the evaluation of the specific absorption rate (SAR) of MIMO systems (multiple-input and multiple-output), in which the relative phases between the antennas are rapidly changing over very short durations.

The fourth paper, entitled “Investigating Sub-THz PHY Layer for Future High-data-rate Wireless Backhaul”, is authored by G. Gougeon, Y. Corre, M. Z. Aslam, S. Bicaïs and J.-B. Doré and is dedicated to future networks. It analyses the feasibility and characteristics of the in-street sub-THz mesh backhauling. The study relies on a highly realistic simulation of the physical layer performance, based on a detailed geographical representation and on ray-based propagation modelling, for a new modulation scheme resistant to phase noise impairments.

The fifth paper, entitled “Multi-beam Modulated Metasurface Antenna for 5G Backhaul Applications at K-band”, by J. Ruiz-García, M. Faenzi, A. Mahmoud, M. Ettorre, P. Potier, Ph. Pouliguen, R. Sauleau and D. González-Ovejero, explores the use of a new modulated metasurface (MTS) antenna topology as a solution for wireless backhaul at K band. The authors show that employing a modulated MTS, combined with the compactness of a pillbox approach, leads to a high-gain and low-profile antenna.

The sixth paper “Bandpass NGD function design for 5G microwave signal delay synchronization application” by S. Lalléchère, L. Rajaoarisoa, L. Clavier, R. Sanchez Galan and B. Ravelo, introduces a design method of simple bandpass (BP) NGD topology. The authors show that the BP NGD circuit can be useful for the improvement of phase linearity and group delay equalization of future 5G microwave devices.

The seventh paper, entitled “Enhanced Integrated Multiband HPM Radiator, combining a Hyperband Source with a High-Q Frequency Selective Surface” is authored by F. Albarracin-Vargas, F. Vega, C. Kasmi, D. Martinez and L. Ole Fichte. This work presents advances on the development of a resonant radiator and shows also that the system analysis methodology can be applied to other FSS geometries.

The last paper, by T. Caillet and entitled “Compatibility between EESS (passive) in band 23.6–24 GHz and 5G in band 24.25–27.5 GHz”, describes the studies undertaken by several European countries for the protection of frequency bands used by satellites for the observation of the Earth. The elements provided in this document are the basis of the European position for WRC-19 on the protection of passive EESS in 23.6–24 GHz.

We hope that this special issue offers you the possibilities to have a wide view on the future networks, existing questions and challenges.

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