New RF System-Integration Solutions and Integrated Antennas for 5G mmWave and 6G THz Applications

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Abstract
The on-going commercialization of 5G focuses on 5G systems which operate in the sub-6 GHz spectrum. R&D of 5G mmWave systems which operate in the 24-29 GHz and 37-40 GHz bands is underway worldwide. These 5G mmWave systems are expected to enable peak data rates of about 20 Gbps and latency of approximately 1ms. Unlike 5G, 6G is expected to operate above 100 GHz, e.g., in the D-band, and would enable data rates up to about 1 Tbps as well as latency of approximately 100 µs. Such extremely high data rates and low latency, combined with novel artificial intelligence techniques, will enable new applications that would transform our lives, economy and society.
However, the development of miniaturized 5G mmWave and 6G THz systems is challenging, partly because of very high channel losses in the mmWave and THz bands, which have severe impact on signal-to-noise ratio and throughput. To overcome these challenges, new massive MIMO and hybrid beamforming architectures are required. For the hardware implementation of these architectures, advanced packaging solutions which enable cost-effective, energy-efficient, reliable and low-loss integration of frontend ICs, high-gain antenna arrays and passive components are required.
In this talk, new RF system packaging and integration solutions with planar and 3D antennas for 5G mmWave and 6G THz applications will be presented. In the first part of the talk, scalable 5G system architectures and the requirements of 5G mmWave on electronic packaging will first be introduced. RF system integration platforms from academia and industry worldwide will then be presented. New antenna-in-package (AiP) solutions and examples of planar antennas for single and dual-band 5G connectivity will be discussed. In the second part of the talk, potential applications of 6G, and initial results of the first 6G D-band project funded by German Federal Ministry of Education & Research will be presented. Finally, 3D antennas for these mmWave and THz applications will be discussed.

Bio

Ivan Ndip has been with Fraunhofer IZM for over 20 years, and currently leads the department of RF & Smart Sensor Systems in Berlin. He also leads the Fraunhofer IZM Branch Lab for High-Frequency Sensors & High-Speed Systems in Cottbus.
Ivan drives 5G and 6G research at Fraunhofer IZM. He has authored and co-authored over 200 scientific publications in peer-reviewed journals and conference proceedings. He has also taught Professional Development Courses to hundreds of engineers and scientists worldwide. He is a recipient of numerous Best Paper Awards, and the Tiburtius-Prize, awarded for outstanding Ph.D. dissertations in the State of Berlin. He is also a recipient of the Fraunhofer IZM Research Award, and the John A. Wagnon Technical Achievement Award from the International Microelectronics Assembly and Packaging Society (IMAPS). Ivan is an inventor, and has authored over 35 German, European and US patents.
He served as Director in the IMAPS international Executive Council from 2016 to 2020, and is a member of the Technical Program Committee of many IEEE and IMAPS international conferences. He also serves as Associate Editor of the Journal of Microelectronics and Electronic Packaging. He is a Fellow of IMAPS and Senior Member of IEEE.

Ivan studied electrical engineering at the Technische Universitaet (TU) Berlin and obtained a doctorate degree in 2006. In 2017 he obtained a second doctorate degree also in electrical engineering from the Brandenburg University of Technology (BTU), Cottbus-Senftenberg, Germany.