Invited Paper:

"Ultra-Low Power/Eb and Small Form Factor mm-Waves Transceivers for Near-Field IoT"

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IoT is one of the technologies that form the basis of the new world that we will come to inhabit. When many sensors should be inconspicuously collocated in a small radius defined as Near-Field IoT (NF-IoT), the wireless node form factor should decrease accordingly. Hence, transceivers, with integrated antennas and no external components are the only possible solution. To reduce battery size, the peak power consumption of the transceiver has to reduce as well. For long battery life, the energy efficiency should increase. Hitherto, the existing wireless standards, in the low GHz frequency range, could not cater to the requirements of NF-IoT transceivers in terms of size, power and energy efficiency. Transceivers operating in these crowded bands, need absolute frequency accuracy and external components such as crystals and/or resonators. In addition, the antenna size is too big to be integrated in a small package with the sensors.

In this paper, we introduce Transceivers, without conventional LNA, PA, Mixers or PLL. With no external components, except for a small 3D micro battery or energy scavenger, the transceivers could be integrated together with sensors and unobtrusively disappear in the environment. The choice of mm-Waves enables small footprint and is conducive to low-power and low energy/bit at the same time.

Tutorial:

"THz Integrated Circuit Design and Self-Healing"

The THz gap refers to 0.1THz - 10THz frequency range and this spectrum is under-explored and under-exploited so far. The IC technology provides faster and faster devices and eventually will reach to the THz gap between electronics and photonics. The price for high frequency capability - captured in the fT and fMAX - of the newer technology nodes, is the performance degradation seen as a result of scaling variability. Hence, integrated transceivers in advanced nanometer CMOS are difficult to design using the traditional six sigma circuit design methodology, in part because of their sensitivities to process P, supply voltage V, temperature T, and also to device modeling error.

As a paradigm shift, we envision that self-healing could be successfully applied to THz IC design with the primary goal of using on-chip sensors and actuators, together with algorithms to increase high-frequency transceiver yield. In the tutorial we are addressing the design issues of different transceivers for mm-Waves with the focus on self-healing. Examples of sub-THz radio transceivers, imaging systems, and short-range communication systems, integrated on-chip, will be introduced. This tutorial stems from the author's research work at IBM and Masdar Institute of Science and Technology together with Researchers from Carnegie Mellon University, Pittsburg, PA.

TARGETED AUDIENCE:

The tutorial is tailored to both academic researchers (i.e., graduate students and faculty members) and industrial engineers working on mm-Waves and sub mm-Waves IC Design, in advanced CMOS nodes, CAD and RF testing. The intended audience is expected to come from several groups: (1) RF designers, process engineers and CAD engineers from semiconductor companies (2) R&D engineers from EDA companies (3) RF designers from defense and (5) academic researchers (i.e., University Professors and students).

PREREQUISITES:

Basic knowledge on RF, analog, mixed-signal, digital IC Design and CAD.

KEYWORDS:

IC Design, THz, CMOS, Self-Healing, Transceivers, Imaging, Communication, On-chip Sensors, Actuators, Indirect Sensing, Performance Modeling