Guest Editorial

RF identification (RFID) is an emerging compact wireless technology for the identification of objects, and is considered an eminent candidate for the realization of a ubiquitous *ad-hoc* wireless networks. RFIDs utilize electromagnetic waves for transmitting and receiving information stored in a tag or transponder to/from a reader. This technology has numerous benefits over the conventional methods of identification, including higher read range, faster data transfer, the ability to embed RFID tags in objects, relaxation of line-of-sight requirements, and the ability to read a large number of tags simultaneously. Furthermore, RFID, when combined with other technologies/functions such as sensors, ranging, and polymer elements, opens up a tremendous variety of potential applications that could enable the first truly "ubiquitous cognition and intelligence." Current RFID applications include: retail supply chains, military supply chains, pharmaceutical tracking and management, access controls, sensing and metering applications, parcel and document tracking, automatic payment solutions, asset tracking, real time location systems, automatic vehicle identification, and livestock or pet tracking.

Although RFID is an emerging technology, the principles and first publications date back to the 1940s, when Harry Stockman described the convergence of radio transmission and radar technology—leading to concepts of RFID as known today. Perhaps the earliest application of RFID was the identification of friendly aircraft in World War II. Nevertheless, it took almost two decades of development to come up with the first commercial products. A variety of applications based on RFID appeared in the 1980s (e.g., access authorization, electronic article surveillance, animal identification). While the original applications were mostly related to logistics or keyless entry, this technology is currently being used in a much wider range of applications and these will undoubtedly grow in the future. Nevertheless, the question arises as to whether the chasm has been crossed from an emerging technology to a mature technology with both important economic and social impact. Here we must answer in the affirmative, as billions of RFID devices have been already sold.

There are still numerous challenges in the RFID domain involving, among others, difficulties in the proximity of metals or biomaterials, range enhancement, a multitude of operating frequency bands, integration of minimal-power integrated circuits (ICs) and sensors on low-cost platforms and security, "rugged" flexible materials, effective switching performance and load modulation, collision alleviation, antenna miniaturization, and reliability. RFID technology requires the combination of several scientific disciplines—from analog-circuit to antenna design, from crypto to polymer electronics, and from wave propagation to sensors. It is the aim of this TRANSACTIONS' Special Issue to present a broad overview of the state-of-the-art in RFID.

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He is currently a Professor with the School of Electrical and Computer Engineering, Georgia Institute of Technology, Atlanta. He has helped develop academic programs in highly integrated/multilayer packaging for RF and wireless applications using ceramic and organic flexible materials, paper-based RFIDs and sensors, microwave microelectromechanical systems (MEMs), system-on-package (SOP)-integrated (ultra-wideband (UWB), mutliband, conformal) antennas, and adaptive numerical electromagnetics (finite difference time domain (FDTD) and multiresolution algorithms). He heads the ATHENA Group, Georgia Electronic Design Center, Atlanta, GA (20 researchers). He is the Georgia Electronic Design Center Associate Director for RFID/Sensor/"Green" Electronics research. From 2003 to 2006, he was the Georgia Institute of Technology NSF-Packaging Research Center Associate Director for RF Research and the RF Alliance Leader. In Summer 2002, he was a Visiting Professor with the Technical University of Munich, Munich, Germany, where he introduced a course in the area

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Harald Witschnig (S'02–M'04) was born in Friesach, Austria, in 1975. He received the Dipl.-Ing. and Dr. techn (Ph.D.) degrees (with honors) from the Johannes Kepler University of Linz, Linz, Austria, in 1999 and 2004, respectively.

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Erich Leitgeb (S'97–M'05) was born in Fürstenfeld, Styria, Austria, in 1964. He received the Master degree (Dipl.-Ing.) in electrical engineering and Ph.D. (Dr.) degree (with honors) from the Technical University of Graz (TU Graz), Graz, Austria, in 1994 and 1999, respectively.

From 1982 to 1984, he attended training to become an Officer for Communications in the Austrian Army (his current military rank is Major). In 1994, he began his research in optical communications with the Department of Communications and Wave Propagation, TU Graz. Since January 2000, he has been Project Leader of international research projects in the field of optical communications and wireless communications. In 2000, he established and currently leads the research group Optical Communications (OptiKom), TU Graz. He was the Austrian Management Committee (MC) Delegate and Project Coordinator of the finalized COST 270 (reliability of optical components and devices in communications networks and systems) and the Sub-Workpackage Leader of "Clear Sky Optics" of the finished European Union (EU) project SatNEx [a Network of Excellence (NoE)]. He was the second Austrian MC Delegate of the finalized COST 291 and is currently one of the Working Group leaders within the new COST action IC0802 and the Sub-Workpackage Leader of "Optical

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