Wideband Impedance-matched Integrated Transceivers for Future THz-band Wireless Networks

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The explosive growth in personal wireless connectivity is rapidly consuming the available spectrum in the RF and microwave bands. Major service providers and consumer electronics manufacturers are already investing in the millimeter wave band to develop transceivers to accommodate extremely large data rates needed for high-speed inter-device connectivity. It is not surprising that the next frontier in wireless spectrum utility will be the THz band.

Possibility of long-distance THz communications has previously been studied by several authors (J. Federici and L. Moeller, Journal of Applied Physics, 107, 111101, 2010; T. Schneider et al., IEEE Trans. on Terahertz Science and Tech., 2, 250-256, 2012). Atmospheric windows with lowest attenuation, suitable for such THz links are also well-known. Nonetheless, a major hindrance for THz communications continues to be the lack of portable, low-cost, high-power transmitters and receivers. In particular for the higher THz band (above 500GHz), lack of high-speed electronic amplifiers and integrated receivers continue to abate interest in wireless THz transceivers. Furthermore, the diminishing power levels of available THz transmitters and the relatively high atmospheric attenuation necessitates highly optimized receiver architectures. As such, achieving an excellent impedance match between the highly-reactive output of the THz sensor and the initial low-noise amplifier (LNA) is of utmost importance.

In a previous work, we developed an active matching circuit for a THz diode (sensor) and a 50Ω input of the subsequent LNA stage, and we demonstrated over 30dB improvement over a 1GHz bandwidth. Currently, we are working to fabricate this matching network together with the THz sensor on a single chip. To do so, it is necessary to use the same material system as that of the THz sensor. A 230 GHz receiver using a Schottky sensor integrated with the proposed active matching network that addresses these design constraints will be presented at the conference. This on-chip matching approach not only will improve receiver performance, but also will reduce cost significantly.