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**PRESENTATION ABSTRACT**

**Battery-less Devices in Mobile Networks: Backscatter Communication and Positioning for Ambient IoT**

The Internet of Things is widely regarded as a key enabler of digital transformation, yet most deployed IoT devices are battery-powered — limiting their lifetime, increasing maintenance cost, and contributing to growing electronic waste. Ambient IoT (AloT) addresses this by targeting devices that consume orders of magnitude less power than existing 3GPP low-power wide-area technologies, ideally operating battery-free by harvesting energy from ambient sources. After completing the first normative specifications in Release 19, 3GPP is now extending the framework in Release 20, with backscatter communication as a central enabling technology.

In this keynote, we examine AloT from an electronics and systems perspective. We first discuss the architecture and circuit-level constraints of backscatter tags — including envelope-detector receivers, passive modulators, energy harvesting front-ends, and the resulting trade-offs between sensitivity, data rate, and power budget. We then describe how backscatter communication can be integrated with mobile networks, illustrated by a Long Term Evolution (LTE) demonstration in which the Cell-Specific Reference Signal (CRS) serves as the ambient carrier and the User Equipment (UE) channel estimator acts as the backscatter receiver. Finally, we turn to positioning and tracking, presenting two complementary approaches: a purely RF-based scheme in which backscatter tags act as fiducials for radio localization, and a hybrid scheme that integrates visible light communication (VLC) with RF backscatter to exploit the complementary properties of the two modalities.