



Technology Transfer in Computing Systems

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TETRACOM D3. 46: TEchnology Transfer of RFID for Infrastructure Sensing - TETRIS

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Environmental pervasive and battery-free sensing based on Radiofrequency Identification (RFID) technology is gaining a growing interest in both academic and industrial communities and STMicroelectronics is studying possible solutions to enable the automatic monitoring of buildings.

TETRIS TP is aimed at transferring the University of Salento recognized skills on UHF RFID technology into this ST's line of activity in order to verify through a feasibility study whether or not an RFID sensor node can be embedded (drowned) in the concrete and transmit data. The TP was subdivided into three Work Packages. More specifically, in WP1 the requirements to be satisfied by the sensing device in terms of size, working range and frequency, have been individuated and the electromagnetic criticalities have been deeply analyzed.

In WP2, the important aspect of the working frequency of the sensor tag has been considered. Both the possible alternatives (HF at 13.56 MHz, and UHF at 866 MHz) have been analyzed by acquiring and deeply testing a set of HF and UHF commercial tags. In both cases there is a significant impact of the concrete. Nevertheless, the HF tags, even without concrete, do not guarantee a working range suitable for the desired application.

So, the prototype of the passive sensor tag patented at University of Salento has been optimized to work at 866 MHz and has been equipped with a temperature sensor. Moreover, a specific firmware necessary to drive the communication with such sensor has been implemented and then the final UHF sensor tag prototype realized. The UHF sensor tag has been then tested when immersed in concrete structures at different distances from the concrete surface. Due to the extra power needed to the sensor tag to energize sensor and microcontroller, the working distance decreased from 4 m in line of sight to 15 cm when in a concrete block.

Due to such impact, the foreseen test of an HF sensor tag, which in line of sight conditions guarantees only a few cm of working distance, has not been performed.

A strong effort has been instead dedicated to the study of possible antennas capable to effectively transmit the sensed data through the concrete. In particular, a system capable to measure the performance of UHF RFID tags has been used on a selection of well-performing commercial RFID tags three different working conditions, which are represented in Fig. 1: a) without any background material (on air), b) applied on a concrete-block, and c) between two concrete blocks. For all the tested tags the sensitivity, i.e. the minimum power capable to energize the tag circuitry, has been evaluated and in each case a sensible degradation when passing from a) to b) and then from b) to c) has been observed.

The design of a specific tag antenna taking into account the concrete material all around the tag has been then

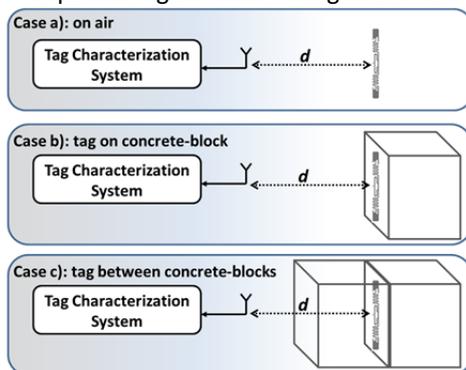


Fig. 1. Experimental setups for the tag characterization in/on concrete blocks.

realized demonstrating that the tag, and hence the sensor tag, can work properly even when embedded into concrete structures. The main outcome is that the radio-propagation through concrete is actually possible, but the device, and in particular the antenna, must be designed by taking into account the dielectric properties of the concrete.

Finally in WP3, the obtained results have been presented to ST's researchers so to perform the knowledge transfer and to

discuss potential future activities.

The success of the TP enforced the collaboration between University of Salento and STMicroelectronics.