Beyond Chipless RFID, the Terahertz Identification

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In this talk, we will mention the possibility of producing chipless tags at higher frequencies that is usually done [1], such as Terahertz. After a brief introduction to the principal motivations for this, we will examine the results obtained at THz frequencies, and then introduce the first chipless tags composed exclusively of dielectric materials, developed by F. Garet's team.

The principle of volume encoding is based on a multilayer dielectric structure of alternating materials with varying refractive index that makes it possible to obtain range of wavelengths where the EM signal is "forbidden" to propagate in the structure [2, 3]. The simplest configuration is the alternation of two layers with a large refractive index contrast. From there, it is known that if we disturb the structure by adding a structural defect (variation of the thickness or of the refractive index of a layer), a peak (or a ridge of peaks) may appear in the forbidden band gap. The idea is to use these peaks to code binary information. This possibility of controlling the position of one or more defects in the forbidden band gap results in a large number of different configurations that can be differentiated without ambiguity on a frequency band as large as several hundred GHz. It has been shown that it is possible to attain around 20 bits using 4 independent defects [4].

The proof of concept was validated on structures made of a stack of silicon wafers separated by air gaps [2]. These were followed by structures produced using paper and polymer materials (cf. in Figure 1). In such cases the high-index layers are obtained by adding mineral materials in paper or polyethylene (for example TiO2 which is classically used in the paper industry). Figure 1 shows a tag that includes a double coding and based on both surface (RF approach) and volume (THz approach) encoding [4].

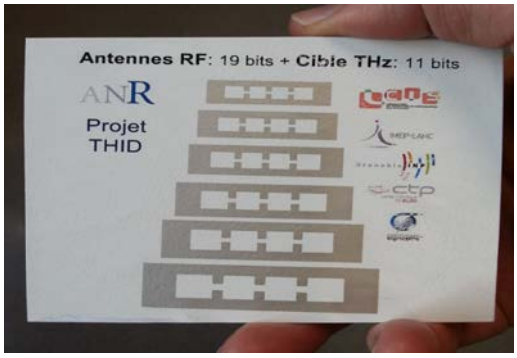

Fig1. Photograph of a THID tag, including surface and volume information (THz approach)

The principal motivations for this study in the THz domain are 1) to increase security of the data contained in the tag; 2) the low-cost character of the solution (no conductive ink used; procedures and materials that are standard in the paper industry); 3) to increase coding capacity, and 4) a new flexibility of use.

1. E. Perret, *Radio Frequency Identification and Sensors: From RFID to Chipless RFID* (Wiley-ISTE), (2014).
2. M. Bernier, F. Garet, E. Perret, L. Duvillaret, and S. Tedjini, *Appl. Opt.*, vol. 50, pp. 4648-4655, (2011).
3. E. Perret, M. Hamdi, G. E. P. Tourtollet, R. Nair, F. Garet, A. Delattre, A. Vena, L. Duvillaret, P. Martinez, S. Tedjini, and Y. Boutant, *IEEE International Conference on RFID*, Florida, USA, pp. 261 – 268, (2013).
4. M. Hamdi, F. Garet, L. Duvillaret, P. Martinez, and G. E. P. Tourtollet, *Annals of telecommunications, special issue on Chipless RFID*, vol. 68, pp. 415-424, (2013).

Invited Paper