Chipless tag printed with common off the shelf inkjet printer and air dry conductive ink

Etienne Perret[1,2], Yoann Hebrard[3], and Pierre-Jean Cottinet[4]
(1) University of Grenoble Alpes, LCIS, Valence
(2) Institut Universitaire de France, Paris, France
(3) SKF Aerospace, Valence, France
(4) INSA-LYON, LGEF, Lyon, France

The cost of the label is essential in chipless RFID. In order to obtain tags with a cost around the same as that of barcodes, it is vital that they be entirely printed [1-3]. Compared to classic RFID, it is the principal argument in favor of chipless [3]. Cost of tags is therefore closely linked to the future success of this technology. In the other hand, printer manufacturers are spending lot of efforts developing digital inkjet printers compatible with conductive ink printing. And chipless RFID is a very good candidate to bring applications to market in the field of smart label printing. Indeed, contrary to other technologies, there is no need to solder common components on the printed label.

The search for extremely low-cost printing solutions is very active [2, 3]. Most of the reported work has employed printers that are too expensive for home use [1]. However, it as be demonstrating that it was possible to produce these tags with printing techniques used in the paper industry; that is, at a very high rate and for a unit cost on the order of around 0.40 euro cents (screen printed on PET [3], flexography on paper [3]).

Today common off the shelf (COTS) inkjet printers are available on the market, for around one hundred euros. Moreover, recently, COTS conductive inks have been developed for use with these low cost printers. This brings new opportunities in field of chipless RFID: we will see here that chipless label can be directly printed with only one layer of ink (direct print without any print head alignment issues…) and without curing. Thanks to this, now, everyone can print is own chipless tags; the conductive ink can be seen as a new color that can be used for the electronic part of the label. In this communication, chipless tags printed with this kind of COTS printer are presented (see Fig. 1). A comparison with same patterns but realized with flexography is done (see Fig. 1.c). The advantage of inkjet technology is the digital printing aspect, which that makes possible to print different patterns, that is to say with different tag IDs. Digital printing is known to have a higher cost per page than traditional offset printing methods like flexography. But it allows for on-demand printing, and a modification of the pattern used for each impression is possible which represents a significant improvement for the chipless technology. By this way, the simplicity of the realization is similar to the barcode, with the advantage here to no need a direct line of sight for the tag ID reading. An Epson home printer with refillable cartridges has been used for the realization of the chipless tag presented Fig. 1.b. JS-B25P silver conductive ink form NovaCentrix has been used. When printed on PET substrate, this air-dry ink presents a resistivity of around 150 mΩ/square. As we can see Fig. 1.c, it is possible to realized one layer chipless tag with performance similar to the one realized by flexography.

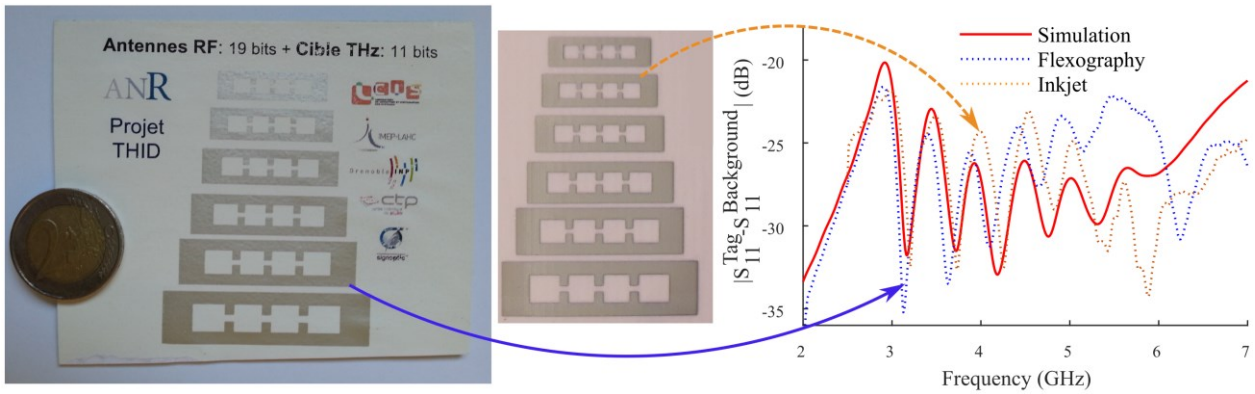

Figure 1. Examples of conductive printings chipless tags produced using a) flexography on paper materials and b) inkjet printer on PET subtract. c) Simulation and measurement results of the two printed chipless tags.

References

1. Y. Li, Z. Rongwei, D. Staiculescu, C. P. Wong, and M. M. Tentzeris, "A Novel Conformal RFID-Enabled Module Utilizing Inkjet-Printed Antennas and Carbon Nanotubes for Gas-Detection Applications," IEEE Antennas Wireless Prop. Letters, **8**, pp. 653-656, 2009.

2. R. Nair, M. Barahona, D. Betancourt, G. Schmidt, M. Bellmann, D. Höft, D. Plettemeier, A. Hübler, and F. Ellinger, "A fully printed passive chipless RFID tag for low-cost mass production," in The 8th European Conference Antennas Propagation (EuCAP 2014), 2014, pp. 2950-2954.

3. A. Vena, E. Perret, S. Tedjini, G. E. P. Tourtollet, A. Delattre, F. Garet, and Y. Boutant, "Design of Chipless RFID Tags Printed on Paper by Flexography," IEEE Trans. Antennas and Prop., **61**, pp. 5868-5877, 2013.