3rd URSI AT-AP-RASC, Gran Canaria, 29 May – 3 June 2022

UHF RFID tags authentication using differential Radar Cross Section

D. Allane[(1)], Y. Duroc[(2)], and S. Tedjini[(1)]
(1) University Grenoble-Alpes, Grenoble-INP/LCIS, Valence, France;dahmane.allane@lcis.grenoble-inp.fr; smail.tedjini@lcis.grenoble-inp.fr
(2) Univ Lyon, Université Claude Bernard Lyon 1, INSA Lyon, Ecole Centrale de Lyon, CNRS, Ampère, UMR5505, 69622 Villeurbanne, France; yvan.duroc@univ-lyon1.fr

Item authentication using passive tags is one of UHF RFID applications that continue to attract a lot of research. The authentication of UHF RFID tags has many goals, like the enhancement of UHF RFID communication security between the tag and the reader, also the protection of valuable tagged items and curbing counterfeiting.

In literature, the authentication issue has been addressed in two ways. The first is the development of cryptographic algorithms that have resulted in authentication protocols for passive RFID tags. These protocols are categorized into four families: heavyweight, simple-weight, lightweight and ultra-lightweight protocols. The first two families require significant computational resources that are not available within the tags, and the last two types of protocols require less resources, but very few of them are able to guarantee full security and resistance to all types of attacks [1]. The second way of approaching this authentication problem is to rely on an analog fingerprint provided by the tag, which is issued from its physical layer. This fingerprint is almost impossible to clone which makes the approach very interesting. However, the difficulty is to find a parameter with enough sensitivity to the small variations that could be present in the tag manufacturing process to be able to distinguish between two tags from the same family (i.e. between two tags of identical reference) [2].

This paper presents a new authentication method based on the physical layer of UHF RFID tags. The proposed concept combines the analog fingerprint of two backscattered signals by the tags at two different frequencies, the fundamental frequency and a harmonic frequency, respectively. Indeed, it is well established that when the tag is interrogated by reader, it generates backscatter signal at the fundamental frequency and its harmonics [3].

So, the principle of the proposed technique is to exploit the variability of the differential RCS (Radar Cross Section) of the tag on a large range of frequencies i.e. fundamental interrogation frequency and its harmonics.

As the differential RCS depends on the two impedance states of the tag chip when it is modulating, this parameter is directly related to the physical layer of the tag, in particular the connection between the RFID chip and the tag antenna. These impedance states are different when considering the modulation at the fundamental and the harmonic frequency, respectively, leading to two different backscattered signals. Therefore, a suitable processing of the measured differential RCS can be used to build a numerical function for authentication purpose and distinguish between two tags from the same family.

1. R. Baashirah, and A. A. Abuzneid, "Survey on Prominent RFID Authentication Protocols for Passive Tags," *Sensors (Basel, Switzerland)*, **18**, Oct 2018, doi: 10.3390/s18103584.

2. S. Chinnappa Gounder Periaswamy, D. R. Thompson and J. Di, "Fingerprinting RFID Tags," in *IEEE Transactions on Dependable and Secure Computing*, **8**, 6, pp. 938-943, Nov.-Dec. 2011, doi: 10.1109/TDSC.2010.56.

3. D. Allane, Y. Duroc and S. Tedjini, "Characterization of Harmonic Signals Backscattered by Conventional UHF RFID Tags," *2021 IEEE International Conference on RFID Technology and Applications (RFID-TA)*, Delhi, India, 2021, pp. 161-164. doi: 10.1109/RFID-TA53372.2021.9617403.