Physical-layer Identification of UHF RFID Tags

Problem Statement

- We explore the unique identification of passive UHF RFID tags.
- We mainly consider same model, same manufacturer tags.
- Identification is based on physical-layer device identification techniques, i.e., by considering physical characteristics, or features, of RF signals.

Results - Highlights

Time domain features
- 50 tags, same model, same manufacturer.
- Distances from up to 6m.
- Different tag orientations and communication powers.
- Classification: Accuracy=71.4%.

Spectral features
- 50 tags, same model, same manufacturer.
- Controlled environment.
- Identification: EER=0.0%.
- Classification: Accuracy=99.6%.

Implications: Tracking & Cloning Detection

- Our work is the first that shows tracking of passive UHF RFID tags is possible with high accuracy from their operating distance (i.e., within 6 meters).
- Tracking is possible despite most privacy-preserving countermeasures on upper communication layers.

- Our work shows that, in controlled environments, it is possible to achieve highly-accurate classification and identification.
- This result motivates the use of physical-layer identification for the detection of product cloning in RFID-enabled supply chain.

Physical-layer Device Identification

- Physical-layer device identification systems aim at identifying (or verifying the identity of) devices or their affiliation classes based on characteristics of devices that are observable from their communication at the physical layer.

Acquisition Setup

- Physical-layer device identification systems aim at identifying (or verifying the identity of) devices or their affiliation classes based on characteristics of devices that are observable from their communication at the physical layer.

Detailed Performance Results

- Identification accuracy of 50 tags, same model, same manufacturer:
  - Spectral features: 99.6 (99.3; 99.9)
  - Time domain features: 71.4 (69.7; 73.0)

- Identification accuracy on different models: 30 tags, 3 different models and manufacturers:
  - Spectral features: 99.6 (99.3; 99.9)
  - Time domain features: 71.4 (69.7; 73.0)

- Feature stability: 10 tags (same model and manufacturer), 10 different configurations of tag position, orientation, and transmission power. Additionally, the acquired signals are down-sampled by a factor of 10.

References


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