Using Interference to Block RFID Tags

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Using Interference to Block RFID Tags

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1. Introduction

- Radio Frequency IDentification (RFID): Great potential, seen dominantly in supply chains.
- Trend towards **item level tagging**
- Example: Requirements for a reader in a store.
  - (Almost) **certain reading** at the door.
  - No reading of tags the store.
- **Our proposal:** Intensional interference to block undesired tag responses.
- Modern readers implements the dense-reader-mode [1]:
  - Readers filter out undesired frequency bands.
  - The tags needs to cope with the interfered signal.

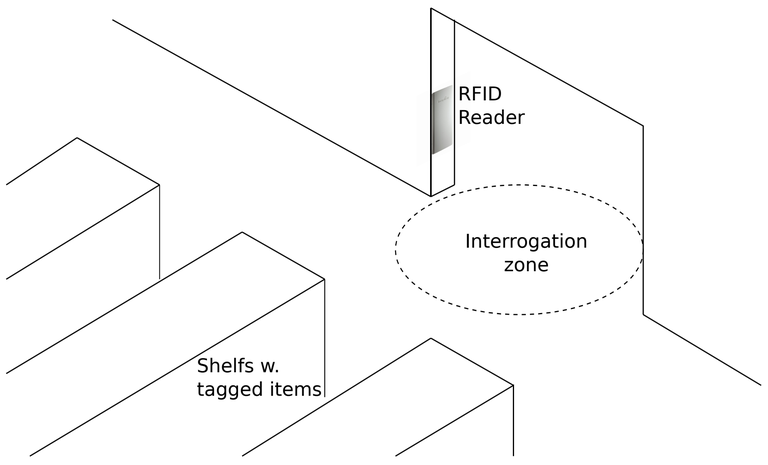


Figure 1: *An application requirering a confined interrogation zone, and tags inside the store to be blocked.*

- **Related work:**
  - Methods to utilize dense-reader-mode [2].
  - No distinction between reader-reader and reader-tag collisions.
- **The focus in this work:**
  - The impact of **interference at the tag** (reader-tag collisions)
  - **Experimental investigation** of the applicability of blocking tags using interference:
    a) Reader-Tag Collision: During the commands from reader to tag
    b) Reader-Reader Collision: During the tag response

2. System Model

- Sample scenario: **Two adjacent readers.**
- Interrogation zone: Area where read probability > 99 %.

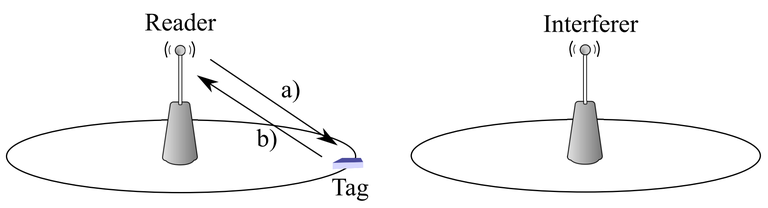


Figure 2: *The considered scenario, where a tag is located between a reader and an interferer.*

- s_r and s_i: Reader and interference signals respectively.
- s_i is modeled with and without AM:
  - Co-Channel Interference (CCI): $f_c = 866.5$ MHz
  - Adjacent-Channel Interference (ACI) #1: $f_c = 867$ MHz
  - ACI #2: $f_c = 867.5$ MHz

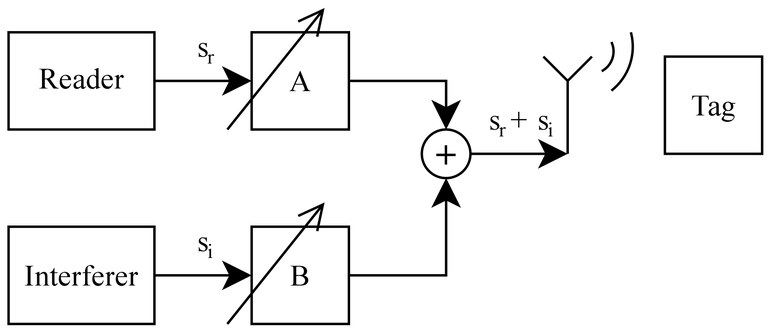
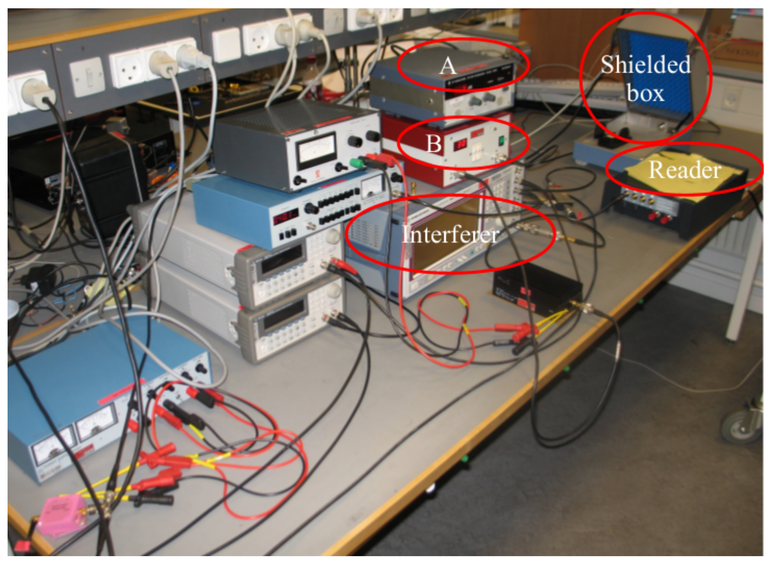


Figure 3: *Signal flow diagram of the utilized experimental setup. Distances are introduced artificially using the signal attenuators A and B.*

- A and B: Adjustable attenuators.
- Reader: Intermec IF5 (dense-reader-mode not supported)

3. Experimental Setup



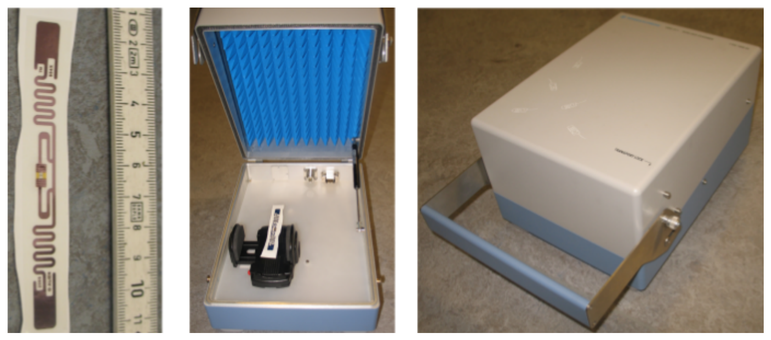


Figure 4: *The utilized tag, an Alien ALN9640 (Passive, UHF), and the shielded box, with the coupling element (black) and the tag.*

- **Focus: A tags ability to interpret reader commands** under interference.
- A tag requires the commands:
  `Preamble + Select + Query`
- Interferer is on during initiation of the interrogation round (**tag response undistorted**).
- Discrete set of Signal to Interference Ratios (SIRs): Response probability based on $n = 500$ interrogation rounds.

4. Results

- **High SIR required** to maintain good response rate.
- Reader-tag collisions (at 99 % level):
  - **Modulated interference has the most significant impact.**
  - A ≈ 10 dB difference between modulated CCI and ACI #1.
  - Interference impact decrease for increasing frequency distance.

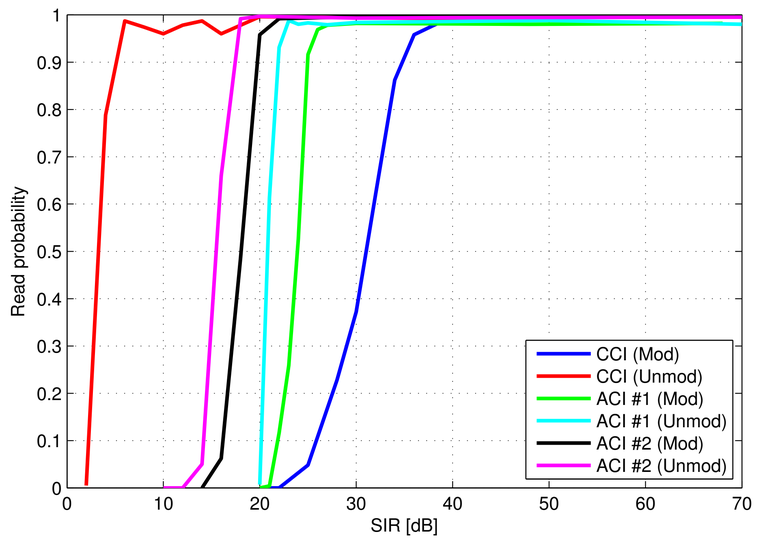


Figure 5: *Read probability for reader-tag collisions plotted as a function of SIR.*

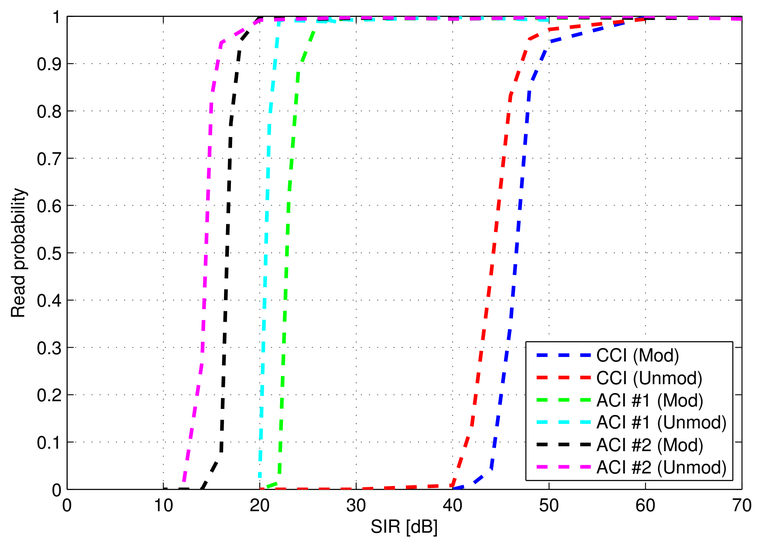


Figure 6: *Read probability for reader-reader collisions plotted as a function of SIR.*

- Reader-reader collisions:
  - **Constant difference between unmodulated and modulated interference.**
  - CCI and ACI #1 are horizontally shifted $\approx$ 25 dB.
- Comparing reader-tag and reader-reader collisions:
  - ACI: Same SIR conditions required.
  - Modulated CCI: **Tag replies at SIR 15 dB higher than the reader** can receive.
  - Unmodulated CCI: Tag response at low SIR.
    * Indicate ability to help power up tag.

5. Conclusion

In this work we investigate the impact of interference at the tag, and whether interference can be used constructively to block tags from responding.

- Result: **We can keep a tag from responding** by imposing interference.
- Interference type showed important: Modulated co-channel interference most effective.
- Blocking of tags enables:
  1) **A sharper separation** of interrogation zones.
  2) **Reduction of false positive readings** of tags.

References

[1] EPCglobal, "EPC Radio-Frequency Identity Protocols Class-1 Generation-2 UHF RFID," no. v1.2.0, 2008.

[2] D.-H. Shih, P.-L. Sun, D. C. Yen, and S.-M. Huang, "Taxonomy and survey of RFID anti-collision protocols," *Computer Communications*, vol. 29, no. 11, pp. 2150–2166, 2006.