

# LODS-MTI: A Link-Adaptive, Orthogonal, and De-slotted Protocol for Robust and Fast RFID Missing Tag Identification

Hongquan Zhou<sup>1</sup>, Zhong Du<sup>1,2</sup>, Xiaolin Jia<sup>\*,2,\*</sup>, Yajun Gu<sup>1</sup> and Hong Yang<sup>2</sup>

<sup>1</sup>Department of Computer Science, University Name, City, Country

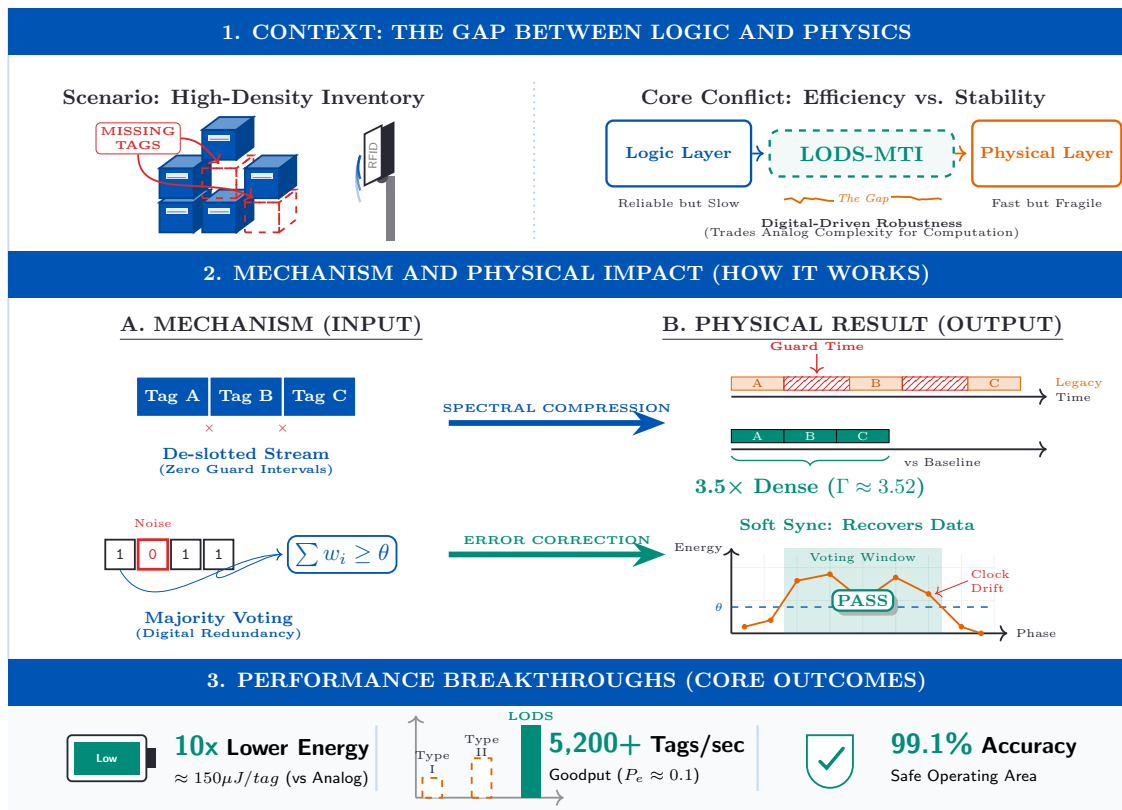
<sup>2</sup>Research Institute, Technology Center, City, Country

**Corresponding author:** Xiaolin Jia *E-mail address:* my\_jiaxl@163.com | **First Author:** Hongquan Zhou *E-mail address:* 2024319433@qq.com

## Abstract

Existing Missing Tag Identification (MTI) protocols trade logic-layer scheduling reliability for physical-layer spectral efficiency. This paper presents LODS-MTI, a Link-adaptive Orthogonal De-slotted protocol that eliminates inter-tag guard times using batch-synchronized continuous bitstreams. To mitigate synchronization loss in de-slotted transmissions, a digital majority voting mechanism corrects single-bit timing slips and accommodates 0.4% clock drift. The design uses short-term coherence through “Power-of-2” batching to replace arithmetic division with bitwise operations. A tolerance-driven feedback loop ( $\epsilon = 0.30$ ) adjusts redundancy based on link quality to maintain a Safe Operating Area (SOA) with 99.10% accuracy within 128-bit windows. Experimental results show that LODS-MTI achieves a normalized time efficiency of  $\Gamma \approx 3.52$  (a 50% increase over baselines) and sustains 5,200–8,811 tags/s goodput ( $P_e \approx 0.1$ ) at  $150 \mu\text{J}/\text{tag}$ , reducing energy consumption by approximately 10 $\times$  compared to analog collision resolution schemes. Code and results are available at [GitHub](#).

**Keywords:** RFID, Missing Tag Identification, De-slotted Architecture, Perfect Hashing, Link-adaptive.



**Graphical Abstract:** This graphical abstract illustrates the architecture and performance of LODS-MTI, a protocol designed to reconcile logical reliability with physical spectral efficiency in RFID systems. 1. Context: Resolves the structural conflict between stable logic-layer scheduling (Type I) and fast physical-layer collision resolution (Type II). 2. Mechanism: Replaces guard intervals with a de-slotted continuous stream for spectral compression. A Digital Majority Voting logic ( $\sum w_i \geq \theta$ ) recovers data from synchronization drift, achieving  $\Gamma \approx 3.52$ . 3. Outcome: Delivers 10 $\times$  lower energy ( $\sim 150 \mu\text{J}/\text{tag}$ ) and sustains 5,200+ tags/s goodput with 99.1% accuracy.

## 1 Introduction

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  \includegraphics[width=0.8\linewidth]{abstract.pdf}
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Table 1 demonstrates the default style.

Table 1. Example Table Style

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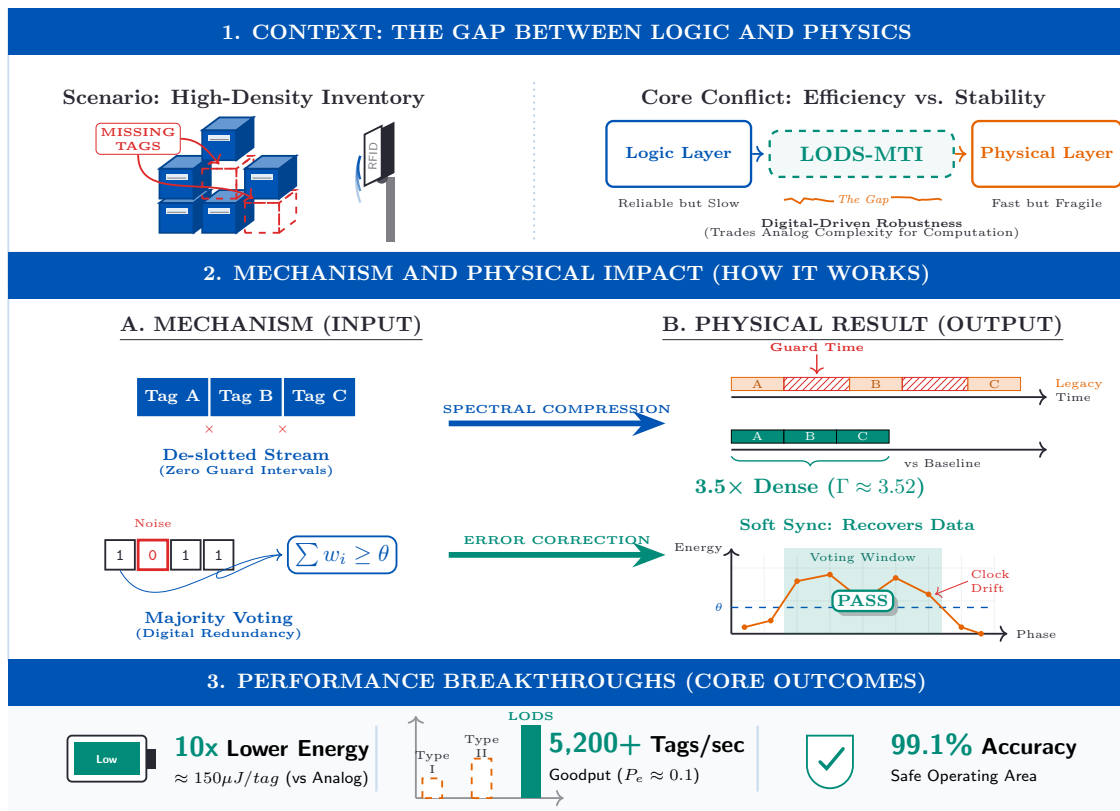
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## References

[1] L. D. Xu, E. L. Xu, and L. Li, "Industry 4.0: State of the art and future trends", *International Journal of Production Research*, vol. 56, no. 8, pp. 2941–2962, 2018. DOI: [10.1080/00207543.2018.1444806](https://doi.org/10.1080/00207543.2018.1444806).

[2] IEEE. "Techrxiv: Preprints for electrical engineering and computer science". (2024), [Online]. Available: <https://www.techrxiv.org> (visited on 03/20/2024).



**Figure 1.** Example of a figure. Note that the caption is left-aligned and colored in Academic Navy.