LODS-MTI: A Link-Adaptive, 0rthogonal, and De-slotted Protocol for Robust and Fast RFID Missing Tag Identification

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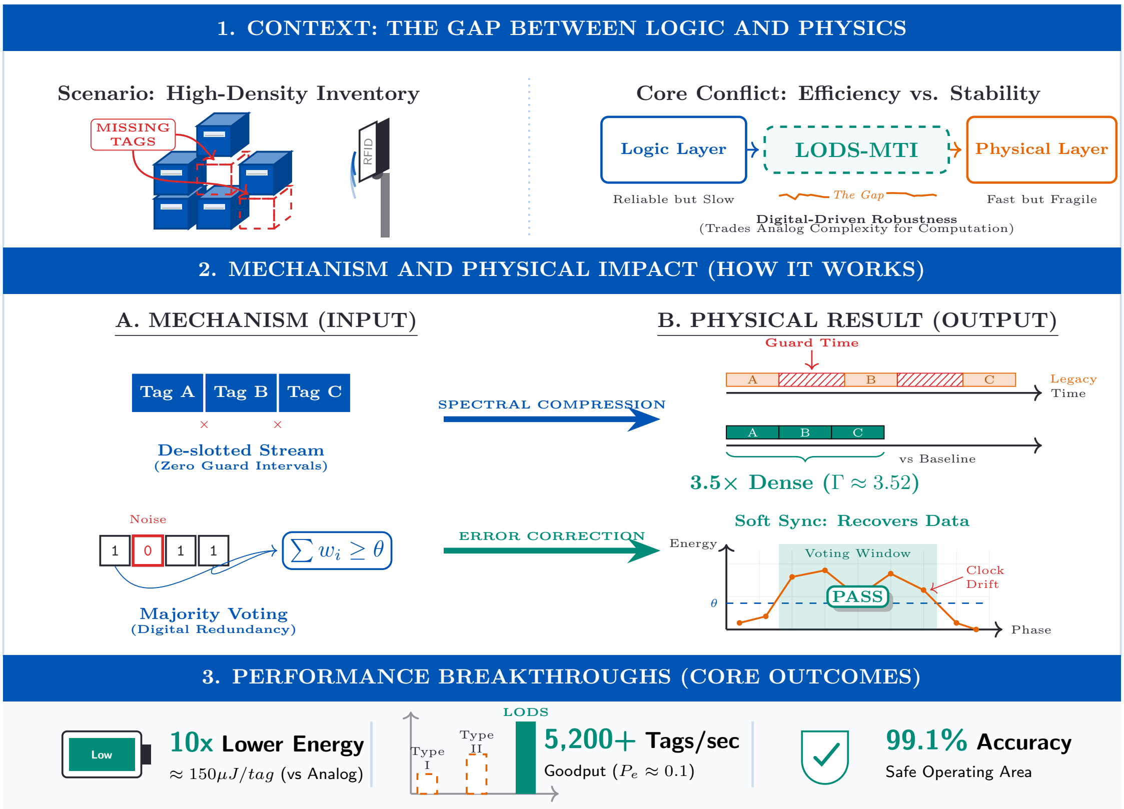
Abstract

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 $150\ \mu J/tag$, reducing energy consumption by approximately 10× 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 10x lower energy ($\sim 150\mu J/tag$) and sustains 5,200+ tags/s goodput with 99.1% accuracy.

1 Introduction

Welcome to the **Rho Class Standardized Template**. This template is designed for academic preprints and articles, featuring a clean, professional "Academic Navy" theme. It is built on the 'extarticle' class and fully supports XeLaTeX compilation.

Quick Start Guide:

1. **Configuration**: Open 'Main.tex' and edit the metadata block (Title, Authors, Affiliations) at the top.
2. **Class Files**: The core logic resides in the 'class/' directory ('main.cls', 'sup.cls', 'cover.cls'). Do not modify these unless you need to change the global style.
3. **Compilation**: Use **XeLaTeX** + **Biber** (for bibliography) + **XeLaTeX** sequence.

2 Template Features

2.1 First Page Elements

- **Header**: Displays the Running Title (') and Lead Author (').
- **Footer**: Contains the Institution Name ('), Preprint Version Date (automatically generated), and Page Number (e.g., "1-5").
- **Metadata**: The bottom rule contains the Correspondence ('), License/Funding ('), and Dates ('). Ensure " is set to enable this block.

2.2 Graphical Abstract

You can include a graphical abstract before the introduction using the 'ommand.

```
\graphicalabstract{
    \includegraphics[width=0.8\linewidth]{abstract.pdf}
    \captionof{figure}{...}
}
```

2.3 Citations and References

This template uses 'biblatex' with 'biber' backend.

- Add your references to 'ref.bib'.
- Cite them using '**key**', e.g., [1] or [2].

2.4 Figures and Tables

Figures should be placed in the 'figures/' directory. Use standard LaTeX environments.

Table 1 demonstrates the default style.

Table 1. Example Table Style

Feature	Command	Note
Lead Author	\leadauthor	Header usage
Institution	\institution	Footer usage
License	\license	Bottom info

3 Conclusion

This template aims to provide an "out-of-the-box" experience for professional academic writing. If you encounter missing footer information, please check that " is present in your preamble.

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.

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

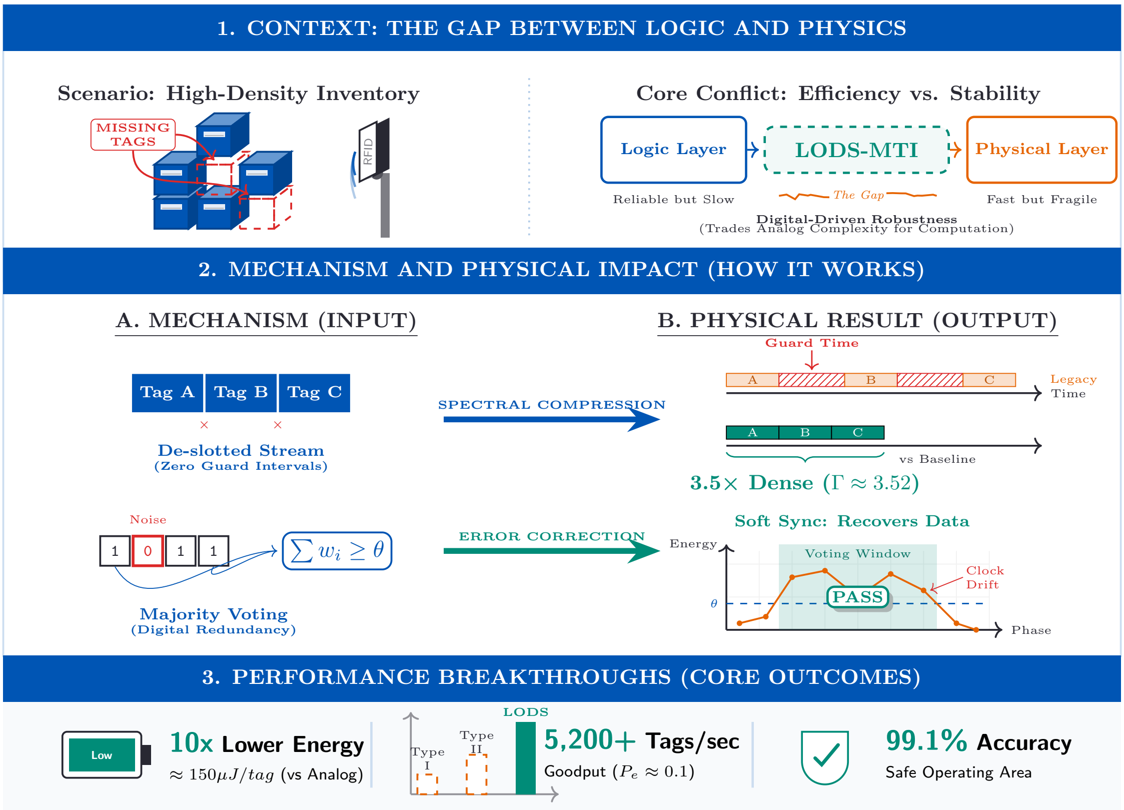


Figure 1. Example of a figure. Note that the caption is left-aligned and colored in Academic Navy.