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Abstract

Missing tag identification is critical for large-scale RFID systems. Existing approaches often suffer from low identification efficiency and reliability in noisy environments. To address these challenges, this paper proposes a novel protocol. By leveraging bit-level synchronization and voting mechanisms, our method tolerates clock drifts and channel errors. Experimental results demonstrate that the proposed method significantly outperforms state-of-the-art protocols in terms of throughput and accuracy, achieving robust performance even under unstable channel conditions. The source code and datasets are available online to facilitate further research in this domain.

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

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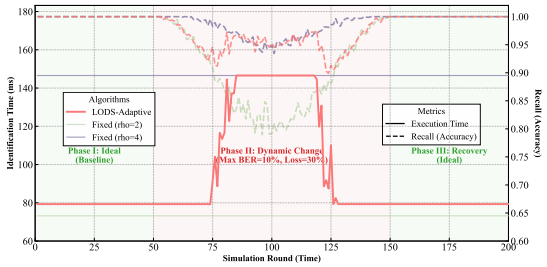

Figure 1. Performance comparison between proposed method and baseline protocols. The proposed method achieves higher recall rates under varying bit error rates.

Table 1. Simulation Parameters.

Parameter	Symbol	Value
Tag Population	N	100 – 1000
Frame Length	L	256 bits
Error Rate	P_e	0.01 – 0.1

1. Introduction

Radio Frequency Identification (RFID) technology has been widely adopted in supply chain management. [1] The quick and reliable identification of missing tags is a fundamental requirement for automated inventory systems. However, traditional slot-based ALOHA protocols introduce significant overhead due to guard times and synchronization requirements. This paper introduces a novel de-slotted architecture that eliminates these inefficiencies.

1.1. System Model

We consider a standard RFID system consisting of a reader and a set of passive tags. The reader communicates with tags using the EPC Gen2 standard.

1.1.1. Channel Constraints

The wireless channel is assumed to be imperfect, subject to fading and noise. We model the bit errors using a Bernoulli process.

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.