**Replies to Reviewers on Manuscript ID ISJ-SH-15-04479**

**“A Closed Form Solution For ALOHA Frame Length Optimizing Multiple Collision Recovery Coefficients Reading Efficiency”**

**Jan 4, 2016**

We thank the editor and the reviewers for their time and effort in helping to improve this paper. In this document we individually respond to all the reviewers’ comments.

**Reviewer #1:**

Thank you very much for your comment. The English of the paper is refined based on your comments.

**Reviewer #2:**

In the proposed paper, authors study the problem of frame length design in RFID applications. Specifically, the case were collisions can be recovered by exploiting proper recovery algorithms is considered. The main contribution of the paper is the derivation of a closer-form formula for the optimal frame length. Author clearly highlights major differences between their work and those in the literature. Numerical results show that the proposed solution outperforms other state-of-the-art solutions. Even though the derivation of a novel closed-form solution is interesting by itself, the technical content is limited. Specifically, analytical derivations are almost straightforward and exploit a well-known analytical tool which limits the technical contribution of the paper. But, obtained results clearly show that the proposed solution improves network efficiency in terms of number of slots needed to identify a group of colliding RFIDs. This latter result makes the proposed solution attractive. However:

1. The numerical section is incomplete. Specifically, it is not clear what technology is considered for the simulated scenario (generation, frequency, etc...) which makes hard to understand the real value of the proposed solution. The reviewer suggests to better describe the simulated scenario.

Authors’ Reply: Thank you very much for your comments and suggestions. The simulation parameters are clarified and highlighted in section 3, which include the channel model, the modulation technique, the sampling frequency, and the symbol rate.

1. Fig. 4 shows obtained numerical results when the number of tags increases from 0 to 1000. Since no description of the considered technology is provided, it is hard to estimate the improvement on network performance provided by the proposed solution. Authors should improve this section. Also, it seems that the improvement in network performance when the number of RFIDs is low (e.g., 100) is negligible if compared to other proposed solutions. Instead, when the number of tags is large, performance improvements are high. Maybe authors would like to identify realistic scenarios where the application of the proposed solution is more beneficial. This would considerably improve the impact of the proposed solution on real-life scenarios.

Authors’ Reply: Thank you very much for your comments and suggestions. According to figure 4, the relation between the average total number of slots and number of tags (n) is almost linear. Therefore, the relative performance of the proposed solution is independent on the number of tags. To clarify that, we have defined in section 4 a new performance metric called Relative Average Saving Time (RAST). This metric is defined as:

RAST[i] = 100\*{(T\_[i]-T\_proposed)/T\_[i]}, where T\_[i] is the average number of slots using [i] algorithm. T\_proposed is the average number of slots using the proposed formula. Then we have calculated the RAST for the showed low and high SNR scenarios. The modifications are highlighted in section 4.

Finally, the typo comments are taken into our considerations in the paper itself.

**Reviewer #3:**

This paper analyzes the optimal frame length of Framed Slotted ALOHA (FSA) algorithms based on the probabilities to recover one tag from different numbers of collided tags. The closed form for the optimal FSA frame length is derived taking the differences in the collision recovery probabilities into account. Simulation results show that the reading time can be saved using the proposed frame length compared to the other existing methods. However, the paper has to be improved by addressing the following concerns:

1. The simulation environment and parameters of wireless communications are not clearly stated.   
   For example, what are the used channel frequency, radio propagation model, and error recovery mechanism?

Authors’ Reply: Thank you very much for your comments and suggestions. The simulation parameters are now clarified and highlighted in section 3, which include the channel model, the modulation technique, the sampling frequency, and the symbol rate. In section 3, the error recovery mechanism is based on a conventional RFID correlator receiver utilizing the capture effect. The received power of each tag reply varies with its channel coefficient. The correlator receiver captures the strongest tag reply. Then, we have calculated the Packet Error Rate (PER) for 2, 3, and 4 collided tags scenarios. Afterwards, we have calculated the collision recovery coefficients alpha\_i based on equation alpha\_i=(1-PER\_i).

The modifications are highlighted in section 3.

1. The performance improvement is minor when using the proposed frame length with less than 100 tags.   
   In addition, the authors must provide the performance results of different methods with the moderate number of tags.

Authors’ Reply: Thank you very much for your comments and suggestions. According to figure 4, the relation between the average total number of slots and number of tags (n) is almost linear. Therefore, the relative performance of the proposed solution is independent on the number of tags. To clarify that, we have defined in section 4 a new performance metric called Relative Average Saving Time (RAST). This metric is defined as:

RAST[i] = 100\*{(T\_[i]-T\_proposed)/T\_[i]}, where T\_[i] is the average number of slots using [i] algorithm. T\_proposed is the average number of slots using the proposed formula. Then we have calculated the RAST for the showed low and high SNR scenarios. The modifications are highlighted in section 4.

1. Instead of only conducting simulation results, the authors must provide experimental results to verify the correctness of the derived analytical model. In particular, the performance improvement has to be evaluated through experiments comparing the proposed frame length to other existing methods.

Authors’ Reply: Thank you very much for your comments and suggestions. This paper proposes a new performance metric which is the multiple collision recovery reading efficiency. Then, an example for calculating these coefficients using simple RFID receiver is proposed. Afterwards, a novel closed form solution for the optimum frame length is analytically proposed. In this paper, we want only to prove the concept and show the benefits of proposed model compared to the literature using simulations results. Therefore, we have submitted this work in a short paper of ISJ which is limited by 4 pages. Nevertheless, the experimental results will more clarify the benefits of the proposed model. To show the experimental results, we need the following steps:

* An implementation of a complete open source RFID reader.
* A testbed that can spy the RFID medium to show the differences of between the conventional readers and the proposed one.

We have already started this process, and it is in the top of our future plan. Therefore, we chose to submit a short paper not a regular ISJ paper, only to prove the concept. Attached to our second submission, a poster for a demonstration presented by our team. The poster shows a testbed system that can evaluate the performance of any RFID reader practically. However, the final version of our own reader is still under construction.

1. The paper content (addressing the medium access issue of wireless communications in the 4-page paper) seems to be more feasible for IEEE Communications Letter than IEEE Systems Journal.

Authors’ Reply: Thank you very much for your comments and suggestions. The proposed work is more related to the RFID technology than the normal wireless communication. ISJ is one of the most popular IEEE journals which include RFID as a specific issue and short version limited by 4 pages.

Finally, the typo comments are taken into our considerations in the paper itself.