Enabling Universal Visibility in Baggage Tracking with RAIN

RAIN RFID Alliance
Whitepaper

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1.0 Introduction

RAIN RFID is used globally in different industry verticals to identify, locate, and authenticate items and things. The aviation industry has adopted RAIN RFID for identification and tracking of parts, supplies and baggage. This white paper focuses on the use of RAIN RFID for baggage tracking and the importance of tag data encoding schemes to enable universal visibility during the process of baggage tracking.

RAIN RFID technology is embedded in almost everything we touch or consume and as a consequence the ability to select correct tagged items such as baggage or airplane parts in multiple tag environments can be challenging. Baggage tracking being one such application. The adoption of RAIN RFID technology for baggage handling by the aviation industry can be attributed to the passing of Resolution 753 by the International Air Transport Association (IATA) that "*encourages airlines to further reduce mishandling by implementing cross-industry tracking for every baggage journey*" i.e. error-free baggage handling throughout the journey of the baggage. The main objectives and benefits of implementing this resolution by IATA members are:

- to reduce the number of lost bags
- help airlines meet the demands of today's connected passengers
- develop a robust infrastructure and processes to enable airlines to manage the growth in global passenger numbers over the next decade.
- RAIN-RFID technologies low tag cost, tag read agility, non-line of sight multi meter read range and low reader maintenance makes it a perfect and the preferred choice.

The overall journey of baggage is complex with multiple touch points and opportunities for mishandling of bags as indicated in Figure 1. Baggage with RAIN tag needs to be identified with a selectable universally understood unique identifier to ensure it is handled correctly on its journey by multiple service providers.

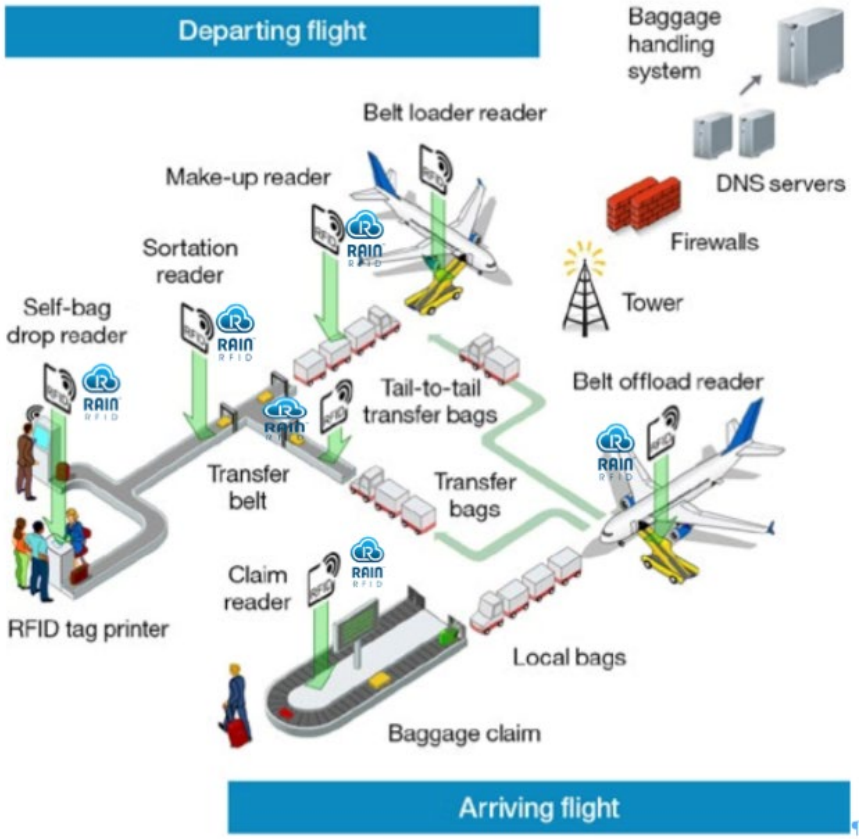

Figure 1 - An airline's example baggage operation

Figure 1 provides an overview of baggage flow at a typical airport. Resolution 753 requires that baggage be tracked at check-in, aircraft loading, arrival, and transfer/change of custody between carriers. Often, things can and do go wrong due to the many different stages in the baggage handling process.

Introducing RAIN RFID for identifying baggage has its challenges as previously stated. Baggage may contain multiple RAIN RFID tags. They can be found in various items such as garments and electronics. Having multiple unrelated tags participating in time-limited tag inventory events reduces the probability of reading the tags of interest during baggage loading/unloading and at sorting stations. This, in turn, can negatively affect the reading of baggage tags resulting in missed reads which contributes to the misrouting of a bag.

In order to reduce the probability of missed reads, the RAIN air interface protocol supports the selection of specific populations of tags. The ability to select only tags of interest and that they, and only they, participate in an inventory round is critical to ensuring the right bag gets on the right aircraft. The ability to select a population of tags is only possible when the encoding of tag data is according to standards where recognizable selectable universal common identifiers are included in the tag data.

The IATA Recommended Practice 1740c on Radio Frequency Identification (RFID) Specifications for Interline Baggage outlines detailed encoding requirements based on ISO standards to enable universal visibility and ease of deployment. Next part of this document provides a high-level overview of encoding standards available and what is used for baggage identification.

2.0 Global Numbering System

RAIN RFID Numbering Systems standards are provided by GS1 and ISO. They are also referred to as data construct standards.

- GS1: EPC Tag Data Standard - Release 1.13
- ISO: ISO/IEC 15961-3

These standards outline the encoding requirements and global numbering system formats to ensure co-existence of open and closed loop applications as explained below.

Open loop applications: In open loop applications a change in custody facilitates a need for sharing identification information of a baggage tag with partners and/or the public. The ability to share identification information automatically results in efficiencies for all stakeholders. To facilitate automatic sharing of information, the data on the RAIN tags need to be programmed consistently in formats that can be understood by all stakeholders across the entire journey of the bag. This is only possible when all stakeholders are aware of the encoding rules and those rules correctly followed. In general, in applications where there is a need to share data, owners of the data need to register data constructs with appropriate recognized registration bodies. These registries then hold the information that allow stakeholders to encode, decode and interpret information programmed in tags. The registries must be maintained consistently, secure, and be electronically accessible on the internet.

Closed loop applications: In closed loop applications, the information on the RAIN tags is not meant to be shared and /or traded and where the user at the source is often in full control of the items or things. It is important that the tags used in closed loop application are programmed and identifiable as closed loop to avoid any confusion when in interrogation zone of an open loop application.

Problems mainly arise when either the users of open loop or closed loop systems do not follow the encoding rules resulting in the potential misinterpretation of data where there is a mixed (open / closed loop) tag population. As adoption of RAIN technology increases, the possibility of having a mixed population of open loop and closed loop tags in the defined read zone increases. Without correct encoding rules, or the awareness of the right encoding rule there is a high chance that the reader either reads the wrong tag or misses the tag needed to be read.’”

RAIN tags support identification classifications of items where the type of items being tagged include a unique identifier. The classifications and identifiers are defined in ISO and

GS1 data construct standards. Industries adopt one or both of the two standards to uniquely identify items.

IATA has adopted ISO data construct standards to identify baggage and other airline specific assets and GS1 Data constructs for applicable consumables used in the aircraft.

ISO encoded tags include an AFI (Application Family Identifier) to enable universal (global) visibility and identification. The AFI is used to identifier the industry owner of the data stored in the UII (EPC) memory in the tag. The number of AFIs are limited (8 bits) and therefore most of them are reserved for large global industries or applications. AFI's are managed and issued by AIM, Inc. Three AFI's have been allocated for closed loop tracking to support small entity general use application. The process of tag selection of a population of tags of interest is enabled through a logical selection of common programmed data and includes AFIs.

IATA has been assigned two AFIs, one for ULD/assets and one for baggage. This allows IATA members to select IATA only encoded baggage or ULD tags during a read process.

IATA in participation with its members create common data construct formats associated with the assigned AFI's and make them available to their members.

Organisation or Standard	AFI (HEX)	UII Encoded Data Format (Decimal)	Monomorphic-UII Compaction	Monomorphic-UII MH10 Data Identifier	Object Identifier for Unique Item Identifier (UII)	Data Format for additional data (Decimal)
IATA RP1640 ULD containers (using 18000-63 tags, with separate UII memory) See Note A	0x91	11	Not applicable		1 0 15961 11 5	11
IATA RP1740C baggage handling [separate UII memory]	0xC1	12	Not applicable		1 0 15961 12 1	12

The encoding scheme used for baggage tags as per IATA RP 1740c (best practice document for using RFID for baggage identification) was developed to enable global identification in an open loop application where there are multiple touch points by different stakeholders. This standard follows the ISO standards for both the protocol to interact with the tag and the encoding of the data placed on the tag.

3.0 What does the implementation of the RAIN technology really mean in baggage tracking?

Missed tag reads result in lost baggage, leading to additional handling costs, customer dissatisfaction, and brand harm. Baggage tags are applied at check in. A clear process has to be followed to ensure that the encoding of data on the baggage tag is done correctly. Baggage labels with embedded RAIN RFID tags are programmed by RAIN RFID enabled barcode printers.

The RAIN RFID tag is energized during the print process. The typical tag reader programming process is as follows:

1. Encode the UII (EPC) memory as per IATA bag tag data construct specification. Program airline-specific data in user memory if required. In certain cases, the reader may also overwrite the existing information if not locked or perma-locked.
2. Verify that the encoding has been done correctly.
3. Read the data on the RAIN baggage tag to be sure that that it is linked to the passenger barcode data that is also printed on the baggage tag label.

4.0 Conclusion

RAIN RFID technology has the capability of fully implementing the Resolution 753. This requires careful and an in-depth understanding of baggage handling logistics and the technology by the different stakeholders. RAIN baggage tags must be programmed according to industry defined standards so the data stored can be understood and differentiated from one another. A logical selection of programmed data on the tag is used to select tag populations. The encoding scheme used for baggage tags is as per IATA RP 1740c according to ISO/IEC 15961-3 rules.

Users of RAIN technology need to be aware of the numbering systems present and how they can be used in selection of specific populations of tags or a specific tag. Irrespective of whether the users use open loop or closed loop systems, it is recommended to follow the defined encoding rules accurately for the successful reading of baggage tags.

5.0 Background and Contributors

This document was developed within the RAIN RFID Aviation Workgroup with the following:

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6.0 Resources

https://www.iata.org/whatwedo/ops-infra/baggage/Pages/baggage-tracking.aspx
https://www.sita.aero/resources/type/surveys-reports/baggage-report-2018
https://www.ibm.com/downloads/cas/MJQOJ1XJ, page 2
https://www.iata.org/en/programs/ops-infra/baggage/rfid/#tab-4
https://www.iata.org/pressroom/facts_figures/fact_sheets/Documents/fact-sheet-rfid-bag-tag.pdf

ABOUT RAIN RFID ALLIANCE

The RAIN RFID Alliance is an organization supporting the universal adoption of RAIN UHF RFID technology. A wireless technology that connects billions of everyday items to the internet, enabling businesses and consumers to identify, locate, authenticate, and engage each item. The technology is based on the EPC Gen2 UHF RFID specification, incorporated into the ISO/IEC 18000-63 standard. For more information, visit www.RAINRFID.org. The RAIN Alliance is part of AIM, Inc. AIM is the trusted worldwide industry association for the automatic identification industry, providing unbiased information, educational resources, and standards for nearly half a century.

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