End-to-End Baggage

IATA BUSINESS CASE REPORT

December 2018

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Introduction

Baggage handling is a critical component of air transportation, engaging multiple stakeholders at different levels on a global scale. Passenger satisfaction and the performance of baggage operations are important aspects of successful airport operations. One of the key drivers of this success is the accurate tracking and processing of information for passenger baggage. Over 4 billion passengers enplaned in 2017, and this number is expected to double to 8 billion by 2034, thereby increasing the demand on baggage handling operations to become more efficient and effective.

In 2018, 22.7 million bags were mishandled, a rate of 5.57 per thousand. Although this figure equated to a 10% decrease on the previous year, the cost to the airline industry was US $2.3bn. There are growing efforts to address this issue and over the past three years the introduction of IATA's Resolution 753 has seen airports and airlines implement systems to enable bag tracking throughout the handling process. This resolution has enabled a positive step towards providing greater visibility of baggage throughout processing, and a reduction in the rate of mishandled bags. While 78% of airlines have an implementation plan for the resolution, much remains to be done for full implementation to be achieved.

Baggage messaging is the communication between airlines and airports that supports the transit of bags from origin to destination. With increasing bags and passengers comes greater need to communicate and interpret this information. Baggage mishandling is often caused or linked to baggage message failures or rejections. Currently, messaging is centrally managed and not easily accessible, creating additional cost burdens to airlines. Implementing standardized messaging processes has the potential to make these communications accessible and intelligible for all relevant stakeholders.

The perception of baggage operations by end users has been changing. When surveyed, 84% of passengers stated that they would like to have bag tracking; two thirds expect this functionality and the remaining believe that the additional services it could provide will be beneficial.

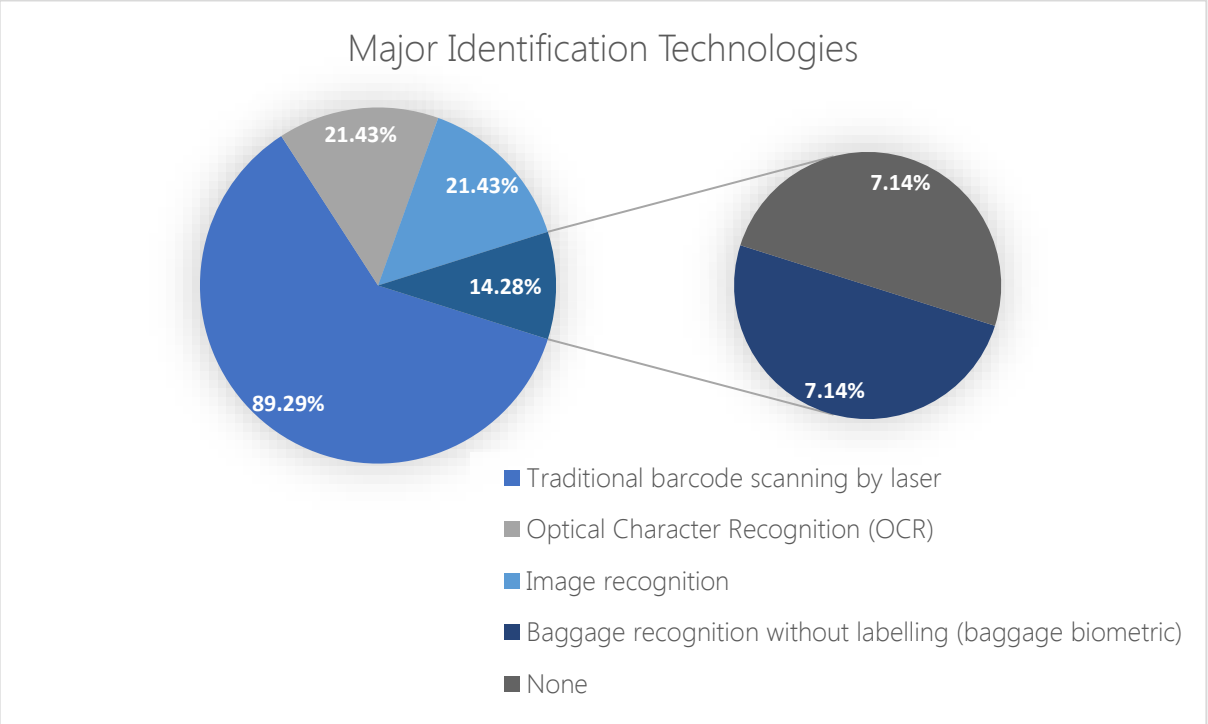
This report presents the aviation industry with an opportunity to use technology to improve baggage handling operations, including baggage tracking and messaging to meet the changing demands of passengers as air travel continues to soar.

Survey

Key to understanding the state of baggage operations worldwide is an understanding of the requirements and challenges of airports that handle bags daily. In 2018, IATA conducted a comprehensive survey of airports that handled 52% of the world's passengers that year.

The survey provided valuable insight into the willingness of airports to embrace innovation and new technologies that reduce rates of misreading and mishandling of bags.

Figure 1: Survey results from IATA RFID Report



89% of airports continue to use traditional reading methods such as bar-coded tags, while 42% stated that they are using either optical or image recognition technologies. A further 7% of airports surveyed stated that they did not use any alternative technologies or have adopted biometric tracking methods. Note that these percentages will not tally to 100% as some airports use multiple technologies in their operations. Further data revealed that 70% of airports surveyed either have or are planning to adopt radio-frequency identification (RFID) for baggage tracking within the next three years.

Challenges

While the survey confirmed a positive approach from airports towards implementing newer methods of bag tracking, up to 7% of airports have no specialised methods of bag tracking at all. It is important to note that not all airports contributed to the initial survey, and the findings present a case for additional fieldwork to capture additional perspectives of airports globally. Seeking further views from airlines should also be sought to align industry expectations and needs in their journey to 753 compliance.

Programme Status

To date, strong support for the development of improved tracking and communications has been found through the IATA airlines and passenger surveys, which highlight interest in such services. Working with airlines and airports directly will build upon the existing interest and enable more efficiency in baggage handling, reduce costs due to mishandling, and meet growing passenger expectations.

Existing Options

Identification & Tracking

There are a range of baggage identification technologies used within the industry. Table 1 below identifies several methods of technology adopted in baggage handling and tracking. Each method is effective for tracking, however they all present different challenges. The attributes of each method are displayed in the table. When comparing the different methods, clear advantages can be seen for deploying RFID technology.

- 1D Barcode: Linear codes only contain alphanumeric data
- 2D Barcode: Two- dimensional data matrix
- RFID: Radio-Frequency Identification
- Bluetooth: Wireless technology exchanging data using short-wavelength UHF radio waves
- NFC: Near Field Communication
- Optical (OCR): Conversion of image of written information into machine code
- Image recognition: Software identification of images in combination with machine algorithms to recognise items.

Table 1: Baggage tracking technology. Source: RFID for baggage tracking white paper

	RFID	1D Barcode	2D Barcode	Bluetooth	NFC
Line of Sight	Not required	Required	Required	Not Required	Not Required
Range	<10m	<1m	<1m	>10m	<10cm
Singulation*	Yes	Yes	Yes	No	Yes
Cost of tags	Low	Very Low	Very Low	Medium	Low
Ruggedness	High	Low	Low	High	High
Read speed	High	Low	Low	High	Low
Bulk reading	Yes	No	No	Yes	No

**Ability to read a tag without interfering with a tag nearby*

Messaging

Baggage mishandling is often caused or linked to baggage message failures or rejections. The existing messaging systems used in business-to-business baggage handling communications have existed since 1985 and have become outdated due to noncompliance with new applications, operating systems and networks. This misalignment means that there are limitations in the development of baggage management systems. To benefit from developments in new technology it is important to develop a more secure and widely accessible messaging standard. XML messaging provides greater simplicity in processing information and is flexible in allowing compatibility extensions to be made.

Recommended Solutions

Through analysis of the research data, Radio Frequency Identification (RFID), XML messaging and the 753 Platform have been chosen as the preferred solutions for the next steps of end-to-end bag tracking.

RFID

RFID uses radio-frequency electromagnetic fields to transfer data and automatically identify and track baggage tags. RFID technology enables many bags to be identified and tracked without the need for human intervention.

XML

XML is a messaging standard with an intelligently designed information model. XML is easily read by devices and people and allows greater integration of information between airline operations. This is an extensible messaging technology which means that it can be added to when required by new information or practices. Despite this, XML is standardised and therefore simple for multiple suppliers to use.

753 Platform

The 753 platform is a tracking and recording opportunity to measure the direct tracking of bags by receiving and interpreting the XML baggage tracking messages. Reporting will be done by IATA to share information on capabilities for recording bags at specific locations at airports, and these reports will be provided back to airlines to support their implementation and baggage operations.

Benefits of RFID

Improve end-to-end tracking

More effective bag tracking leads to the reduction of mishandled bags and efficiency gains in baggage operations. 79% of delayed bags are mishandled which is predominantly due to mistracking during transfers (45%) or errors at acquisition (19%). Poor tracking capability in these key steps of the journey often lead to delayed bags. Manual coding is often required to resolve tracking issues, adding further delay and cost, which can result in the bag not being loaded.

Improve data consistency

Introduction of RFID in many logistics processes, including baggage handling, has demonstrated improvement in the quality and consistency of data, which is vital to provide passengers with dependable information. Current 1D barcodes require a line of sight to be read whereas RFID offers a remote method to exchange information. This results in a significant improvement in tracking read rates. RFID tags are more durable and consistent with regards to presentation of information each time, with fewer issues caused by poor

printing or damaged labels. RFID can also be read outside of the baggage system, enabling proactive decision making by handlers and the potential opportunity for passengers to track their own bags.

Ease adoption of Resolution 753

RFID could reduce the deployment and operational costs linked with adding new tracking points due to the reduced manual intervention in the baggage process. This is because RFID can contribute to baggage identification – not only can a bag be recognised at a single point, it can be remotely identified between tracking points if required. Deployment costs are continuing to reduce as RFID becomes the preferred tracking technology for the wider logistics sector and RFID can be retrofitted to existing systems with limited additional capital expense. In addition to these cost reductions, there are many operational cost efficiencies that can be realised due to reduce manual coding and more efficient un/loading processes. Improved tracking will also improve appropriate recovery of costs from mishandling and inform where the most common issues in a process are occurring leading to informed continuous development opportunities. RFID and XML, therefore, are being proposed as the preferred supporting technologies to achieve Resolution 753 compliance.

Improve aircraft loading/off-loading

RFID would enable baggage to be loaded/offloaded faster due to bulk tracking capabilities, leading to fewer delayed flights. Unit load devices (ULDs) can be scanned and all bags contained are immediately recognised. This is far quicker than the manual process of scanning and moving one bag at a time. Whilst there will always be last-minute bags, the speed of the RFID readers and repeatability of the information exchange enables handlers to load or unload bags more quickly. The minimum connection time at airports is a key unique selling point for airports and airlines and punctuality for departing or transfer passengers is a measured performance factor across the industry. RFID will contribute to quicker, more reliable journeys for all passengers.

Benefits of XML

Reduce cost of messaging

The new messaging standard based on XML will enable the use of modern, scalable and low-cost, cloud-based infrastructure and services to reduce the per-transaction cost of messaging. Furthermore, the XML schema provides a human readable, version-controlled data structure which is simpler to work with than its predecessor. This will reduce the cost of maintaining and changing airport and airline systems utilising baggage data.

Improve data content

The new XML schema allows new passenger services and functions by including more data content than its predecessor and providing greater access to the data.

Meet passenger expectations

Passengers are the most important stakeholders and key drivers of change within the aviation business. Today passengers expect to be informed at each stage of the bag handling process. Building on Resolution 753, XML could enable passengers to be updated at key points of tracking such as check in, sortation, aircraft loading and delivery to arrivals carousels.

Reduce complexity

XML significantly reduces the number of different message formats and creates a drastically simpler way of determining what the message format results in connected systems that are more reliable, and cheaper to change and maintain.

Improve resilience

The new XML messaging standard would improve the resilience of baggage messaging by ensuring that any failure is localised. This occurs because XML replaces communication via a central authority with communication via multiple point-to-point connections.

Improve security

Current messaging lacks data security, whilst the new XML standard can provide encryption and signature of data exchange to ensure the security and authenticity of the information.

Reduce cost of manual handling

When bag data is not available for a bag, it needs to be manually processed and handled by an airline agent. Improvements to the timely communication of bag data to all affected parties will reduce the cost of manually resolving issues, by preventing those issues from occurring.

753 Platform

The 753 Platform is a win-win project for both IATA and the industry; IATA gains insightful data to compliment products whilst the industry gains reports on tracking progress. It is assumed that a basic tier of reporting will be provided to all members who contribute data to the platform. The platform has 2 principle drivers – firstly a request by the IATA Board, during the 206th Board of Governors meeting held in Geneva in 2017, for a tool that enables the progress of 753 implementation to be easily reported, and secondly a business intelligence tool for use in IATA products and services.

As the IATA resolution on baggage tracking applies to all IATA members, it is reasonable to expect that IATA would have an estimation of the implementation progress. The 753 Platform is the method that IATA intends to implement to provide visibility on this.

The 753 Platform Project

The 753 platform is a project that will enable IATA to develop the capacity to report upon, monitor and asses the airlines' tracking of bags. The traditional method of ascertaining industry implementation progress has been to have a team undertake surveys with IATA airline members. This method is unsatisfactory because there is generally a poor response

rate to these surveys and the information gained can have little further use beyond the initial report. The 753 platform is intended to directly measure the tracking of bags; receiving and interpreting the baggage tracking messages themselves.

This will be done as follows:

- Airlines will be invited to share their baggage data with IATA
- IATA will use this permission to approach suppliers to have them send their data to IATA in the XML format.
- IATA will remove all personally identifiable information from the messages (passenger names, etc.) and store only baggage events (e.g. bag number 0125123456 seen at GVA Arrivals on 23/1/2019)
- IATA will develop reporting to share information on capabilities for recording bags at specific locations at airports and provide these reports back to airlines to support their implementations and baggage operations.

Relationship with Resolution 753

The common capability of baggage tracking was introduced by IATA resolution 753, effective June 1st, 2018. This standard does not make recommendations for the technology used for the tracking process but does require that airlines share the tracking information with other interline partners along the bag's journey. The resolution does not specify how this information should be shared, but the only available method at the moment for mass information sharing is the IATA standard baggage messages specified in IATA Recommended Practice 1745.

Relationship with XML

The XML project, referenced previously in this document, is related to the replacement of the messages specified in Recommended Practice 1745 with messages derived from the IATA Airline Industry Data Model (AIDM) and specified in Recommended Practice 1755. The drivers for this transition are messages quality and cost of distribution. In order to reduce the expected costs of data transmission for the platform, XML will be the preferred method of data transfer.

Project Structure

The project has several components and is phased to allow decisions to be made regarding investment as these key phases develop. The stages in **bold** are considered Go / No-Go points. All the dates are indicative and will be firmed up as the project progresses.

Table 2: 753 platform project phasing

Phase	Date	Decision	Governance
Board re-affirm need for platform	December 2018	Is reporting on the progress of baggage tracking needed?	Board
Business requirements development	Until Feb 2019	Have acceptable requirements been developed?	Business
RFP Process	Until April 2019	Are the RFP responses well met?	Procurement
Go / No Go & Funding	**June 2019**	**Decision to implement with chosen provider**	**ProCom**
Airline Engagement	Continuous from Sept 2019	Ordered list of airlines to approach	Business
Data Suppliers Engagement	Continuous from Sept 2019	Suppliers identified and engaged	Business
Platform Operational	**March 2020**	**Platform meets original business requirements**	**Business**
Reporting available	April 2020		
Move to Operations	**Sept 2020 for Jan 2021 move**	**Move to operations or continue as project**	**ProCom**

Engaging with airlines

Airlines will be asked to enter into a Contribution Data License Agreement whereby they agree to share their baggage data with IATA in order to be able to benefit from receiving reports from IATA based on community progress. This is the same mechanism as was used in the DDS (Direct Data Solutions) product. Because we will engage with the airline suppliers to receive the baggage messages, there will be zero cost of participation to contribute this data.

Engaging with Suppliers

Suppliers will be asked to create a publication service that sends baggage messages using the XML standard to an IATA consumer of this data. The suppliers will be offered a recognition of this capability through a “753 Compatible” award from IATA (simply shown on the baggage pages under tracking and reviewed monthly in case the data supply is stopped) when they are capable of sending baggage data in the correct format to the platform. This is separate from the IATA Strategic Partner program, as enforcing membership would increase the costs that the suppliers would incur in sharing data.

Services provided by the platform

The services that could be offered by the platform will be developed during the business requirements definition phase. An initial list could include:

- Which 753 mandated points are being tracked at each airport?
- Which airline have tracking at an airport?
- Which routes are completely 753 tracked (arrival and destination airports)?
- Where a bag was last tracked?
- What routes have the most Rush bags (bags traveling without the passenger)?
- How many bags travel on a route? (by airline, only for the airline) (by route, for the industry)?
- What are the seasonal baggage volume variations for specific airports and routes?
- General data science applications.

Data of this type could form the basis of new IATA products or expand existing products.

Costs

The business requirements for the platform are being developed as part of the existing End to End baggage project with the assistance of the core baggage team. The costs of a project manager for the 2nd half of 2019 is included in this business case to allow for the project to be managed beyond the business requirement definition phase.

In June 2019 the platform supplier costs will be submitted to ProCom to request funding to develop the platform with the successful RFP respondent. At this time the project costs will be fully expanded.

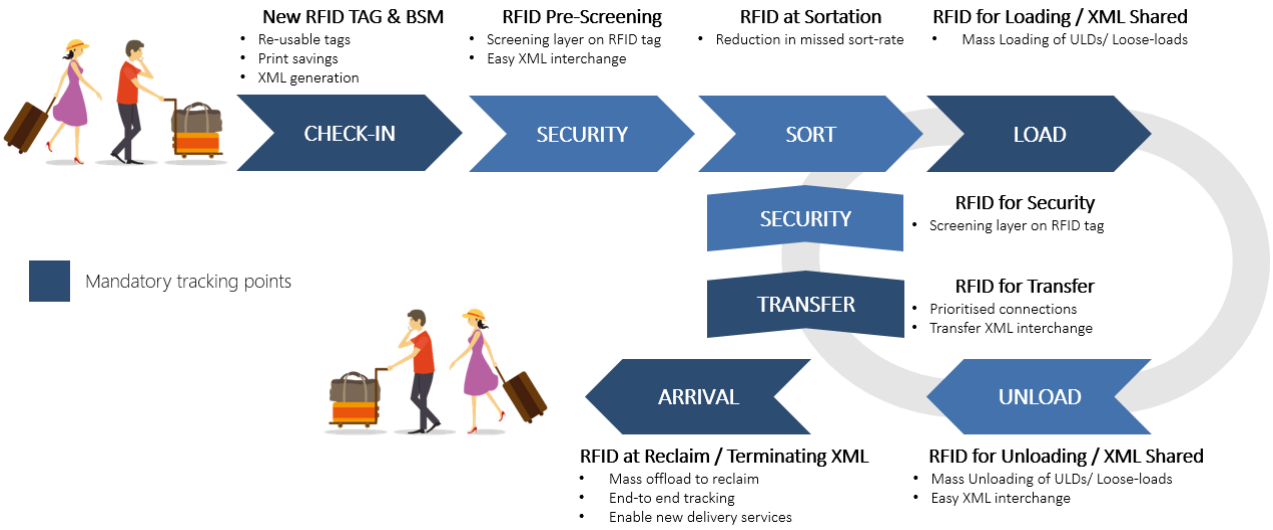
Passenger Journey

The graphic below shows how RFID and XML technology can be implemented together throughout the passenger journey to improve existing bag tracking processes.

XML messaging is easily integrated into existing airport and airline operations. XML-based messaging is an existing functionality that has already been used in various operations such as passenger processing, airline distribution messages and flight related data exchange (AIDX). This type of messaging is low to maintain and widely intelligible resulting in less messages likely to be misinterpreted and therefore bags lost.

Similarly, RFID technology has already been implemented in baggage handling systems and allows more baggage identification to be carried out with reduced human intervention.

Figure 2: RFID and XML overlaid in existing bag tracking process



Global Business Case

This section presents the business case to the aviation industry for the global rollout of RFID and XML, with the aim of improving baggage tracking globally.

RFID

Despite upward trends in the performance of baggage operations in recent years, mishandled baggage costs the aviation industry billions of dollars annually. Additionally, passengers are increasingly expecting to have access to baggage tracking information during their journey. This has created a demand for a technology that provides airlines, airports and ground handlers with information that improves their decisions, efficiency and service quality.

This document has previously presented the benefits case for RFID. Given these reasons, IATA has identified RFID as the technology of choice to fulfil industry demands for improved baggage management. The savings, cost and global rollout plan are presented below.

Savings

RFID creates savings in three main areas:

Improved End to End tracking

More bag tracking leads to a reduction in mishandled bags and efficiency gains in baggage operations. Initial deployments have shown a reduction in mishandled baggage of 25%.

Improved Aircraft Loading and Off-Loading

Baggage is loaded and offloaded faster, which leads to fewer delayed flights. RFID also leads to higher automation, proactive care and therefore a reduction in manual operations.

Easing Adoption of Resolution 753

Deployment and operational costs linked with the addition of new tracking points are reduced. Additionally, the deployment cost is significantly reduced with RFID compared with traditional barcode scanners.

Costs

The costs associated with introducing RFID are divided into capital expenditure and operating expenditure. The source of each cost is defined below.

Capital Expenditure

RFID Printers

The existing printers at the check-in counters or at the self-service kiosks can be upgraded with RFID modules so that they can encode the RFID bag labels.

The cost of printers is taken to be $1,500 per unit and includes a $1,000 installation fee. It is assumed that 12 printers will be required per million bag tags printed annually.

RFID Readers

RFID readers consist of a radio frequency element used to interrogate bag tags via Radio Frequency to get identity and data written on the RFID bag tags, and control unit to manage the reader, aggregate the information collected from the bag tags and transmit it for further processing to data handling and bag management systems.
The cost of a read is assumed to be $2,500, with an additional $5,000 cost for installation

Integration for Bag Tracking

There will be a cost associated with integrating the new system with the legacy system. The assumed cost has been taken at between $30,000 and $150,000 depending on the tier of airport, to facilitate this integration.

Implementation, Project Management, and Additional Costs

The process of rolling out RFID globally will require a project management component which will include training and trialling of systems. The overall cost will depend on region and tier of airport.

Operating Expenditure

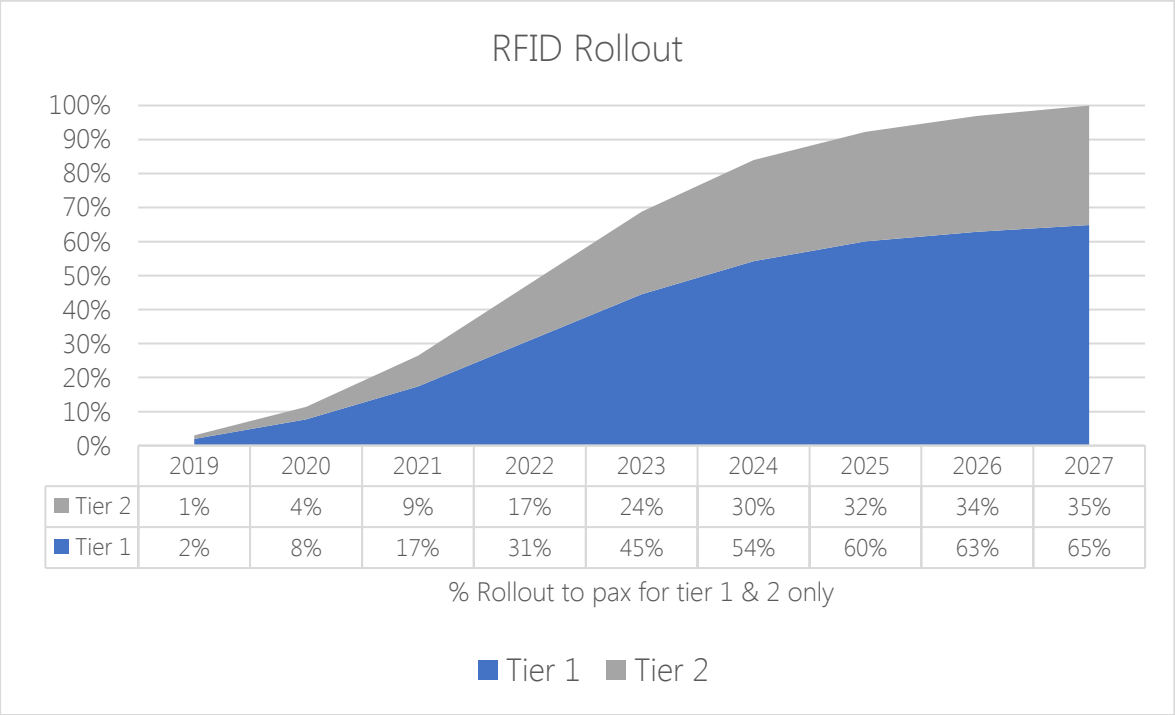
RFID Tags

The RFID bag tag must conform to IATA's Resolution 740 and IATA Recommended Practice 1740c to be used in the common use printers at an airport.
Processing a bag with an RFID bag tag must be transparent to the tools and processes in place to manage existing paper bag tags, and RFID processing capabilities can be added over time, to improve key areas of baggage handling. There will be an operating cost of between 3¢ and 6¢ per tag, depending on the number of units purchased.

RFID Rollout

This business case examines RFID rollout in tiers 1 and 2 airports exclusively. The chart in figure 3 shows the rate of rollout over the proposed period from 2019 to 2027.

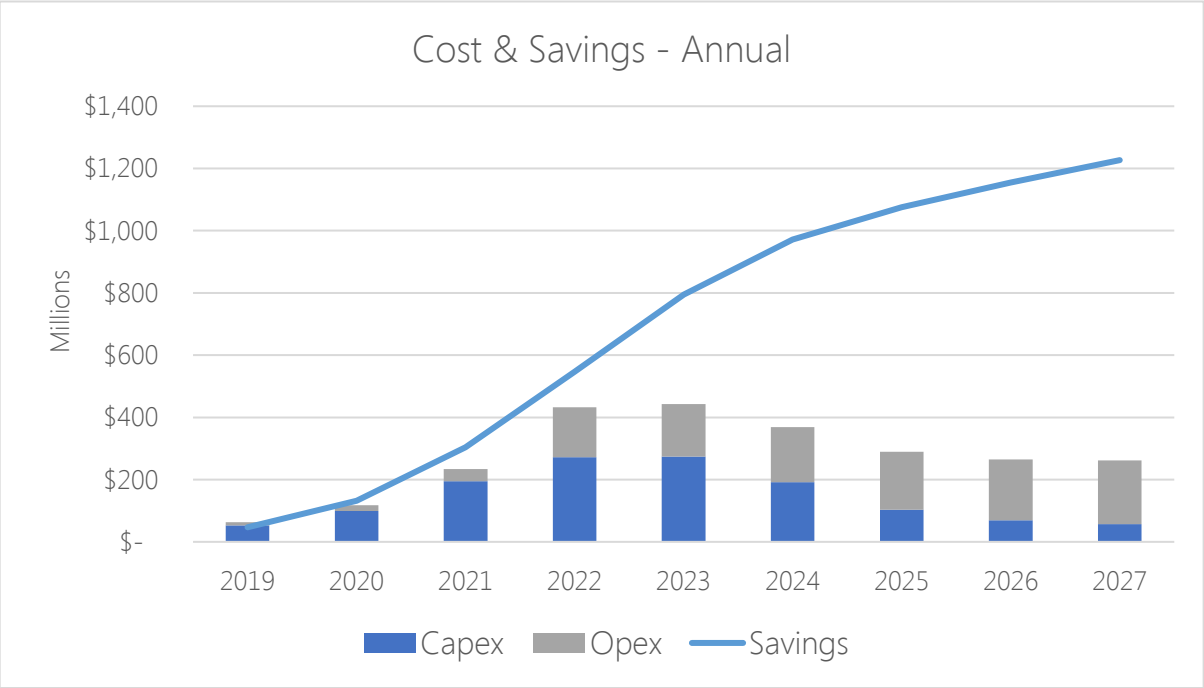
Figure 3: RFI airport rollout plan



Annual Costs vs Savings

Figure 4 shows the RFID costs and savings on an annual basis. The rollout of RFID begins gradually and reaches a peak rate in 2022 before gradually tapering off. This is reflected in the capital expenditure costs, which are distributed accordingly over the nine-year period. The operational costs increase with the rollout and ultimately peak in 2027 when RFID deployment in tier 1 and 2 airports reaches 100%.

Figure 4: RFID annual costs and cumulative savings



Cumulative Costs vs Savings

A projection of the cumulative costs and savings are presented in figure 5, showing that the payback period for the RFID rollout is three years. This is largely reflective of the rate of the rollout, which have achieved nearly 50% by the end of 2022. After the savings curve intersects the cost curve in 2020, the programme will begin running a positive cash flow.

Figure 5: RFID annual cumulative costs

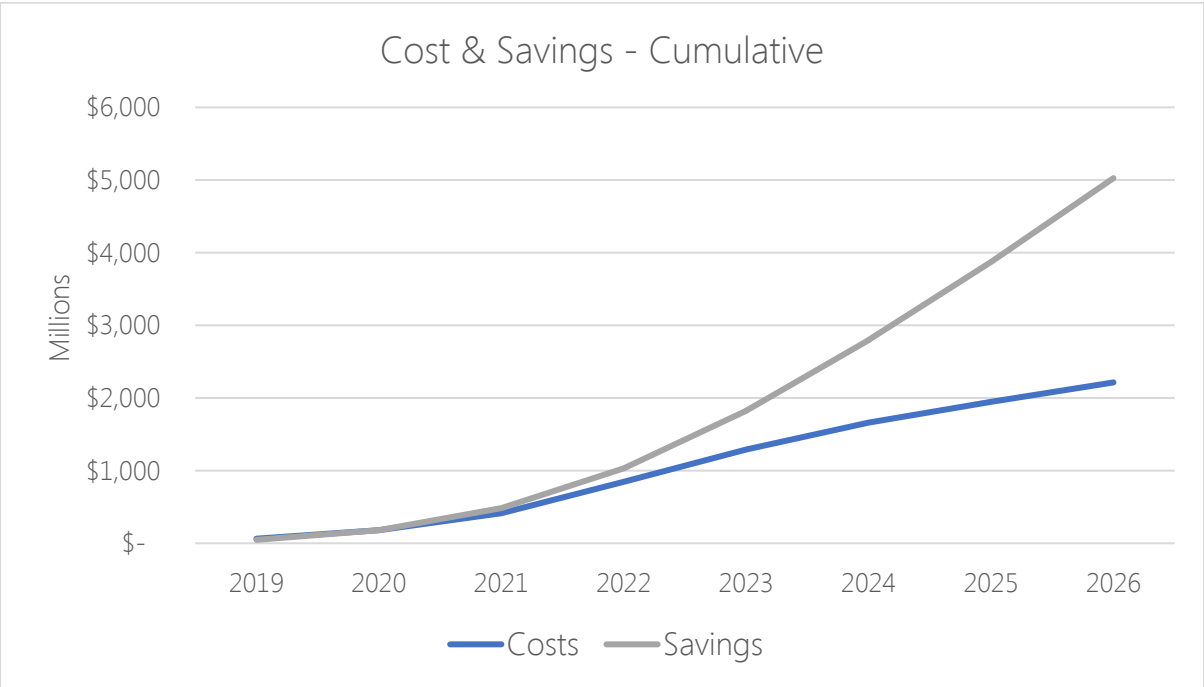


Table 3: RFID Cumulative Cash Flow

Year	Cumulative Cash Flow (millions $)
2019	-£16.1
2020	-£2.1
2021	£68.0
2022	£181.9
2023	£533.7
2024	£1,136.2
2025	£1,922.1
2026	£2,811.6
2027	£3,776.3

XML

This section presents the business case for deploying XML globally to enable a more efficient and cost-effective baggage messaging system for the air transport industry.

Baggage Messaging

Baggage management currently relies on a messaging standard that was developed in 1985 and has not proved to be an efficient way to support baggage system integration and innovation.

Baggage message failure rejections are a major cause of baggage mishandling, impacting customer service and exerting extra costs upon the industry. This results in airlines investing efforts and resources to resolve messaging issues.

The rules governing the practices and development of XML are defined by W3C (World Wide Web Consortium), a respected international body that is not aligned to any vendor or product. The advantage of XML is through enabling much simpler processing to take place, making the task of ''parsing'' the information (putting it into a form that is usable by the receiving device) unnecessary. Once a message is created in XML, all the devices in an enterprise (or wider environment if the same information structure is adopted extensively) can carry out their work simply, without having to reinterpret the message from scratch. XML is also inherently protected against becoming obsolescent, because the structure allows for extension, when new practices require new information to be carried.

Costs

The costs associated with introducing XML are divided into capital expenditure and operating expenditure. The principal sources of each cost are defined below.

Operating Expenditures

Cost of legacy baggage messaging

It is currently estimated there are approximately 24 messages sent per passenger bag handled, and this rate is expected to grow at 3% annually. The overall cost of operating the legacy messaging system each year is approximately one billion dollars.

Table 4: Baggage messaging cost

Baggage Messaging (2018 estimate)	
Total Passengers	4.41 billion
Unique Messages	105 billion
$/message	$0.01
Messaging Cost	**$1.05 billion**

Cost of baggage mishandling due to messaging issues

The cost of baggage mishandling that arises directly from messaging issues is more than $125 million, accounting for 4.7% of the total baggage mishandling cost.

Cost of manual handling due to messaging issues

The annual cost of manual handling due to messaging issues is expected to exceed $20 million this year globally. The larger share of this cost arises from transfer bag handling, as they are subject to significantly more messaging issues than local bags. Estimates for the 2018 cost of manual handling for local and transfer bag messaging issues are presented in Tables 4 and 5, respectively.

Table 5: Local manual handling baggage messaging costs

Baggage Messaging - Local (2018 estimate)	
Total Passengers	4.41 billion
Percentage of local bags requiring manual handling due to messaging issues	1%
Average manual handling time for a local bag	10 seconds
Average cost of manual handling	$12 per hour
Cost of manual handling due to local messaging issues	**$1,470,000**

Table 6: Transfer manual handling baggage costs

Baggage Messaging - Transfer (2018 estimate)	
Total Passengers	4.41 billion
Percentage of transfer bags requiring manual handling due to messaging issues	9%
Average manual handling time for a transfer bag	15 seconds
Average cost of manual handling	$12 per hour
Cost of manual handling due to local messaging issues	**$19,845,000**

Capital Expenditure

Cost of removing legacy interfaces

There will be a cost associated with removing the legacy interface system, which is estimated to average about $39,000 per broker. The total cost for the 2,500 brokers globally will be nearly $100 million, which will be distributed over the nine-year roll-out.

Cost of XML Messaging System

It is estimated that the global capital expenditure required for creating and implementing the XML Messaging System is approximately $678 million in total over the nine-year rollout.

IATA Service

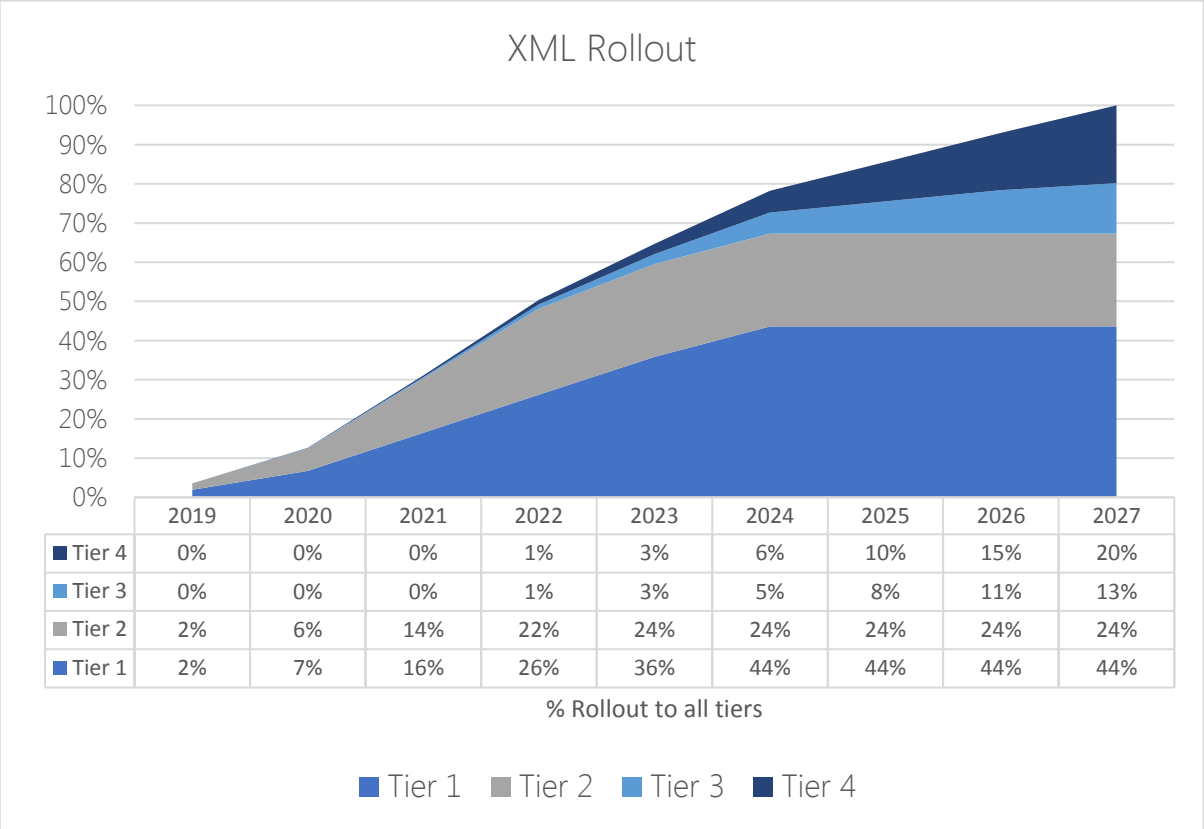
Included in the capital expenditure analysis is the costing of services that IATA will provide for:

- Directory Services – set up, configuration and management of service and authentication.
- Testing Services – this will be comparable to building an airline and airport baggage broker.
- Certification Services – assuming the use of a commercial off-the-shelf product, this service will be required.
- Maintenance – standard for ensuring on-going functionality.

XML Rollout

This business case examines XML rollout for all 4 tiers of airports. The chart in figure 6 shows the rate of rollout over the proposed period from 2019 to 2027.

Figure 6: XML airport rollout plan



	2019	2020	2021	2022	2023	2024	2025	2026	2027
Tier 4	0%	0%	0%	1%	3%	6%	10%	15%	20%
Tier 3	0%	0%	0%	1%	3%	5%	8%	11%	13%
Tier 2	2%	6%	14%	22%	24%	24%	24%	24%	24%
Tier 1	2%	7%	16%	26%	36%	44%	44%	44%	44%

% Rollout to all tiers

XML Business Case Overview

The projection of costs shown in figure 7 shows that the proposed business case begins diverging significantly from the baseline operating expenditure significantly in 2022. This is based on the cost of operating XML messaging services which are in the order of a fraction of the legacy messaging costs

Figure 7: XML annual expenditures

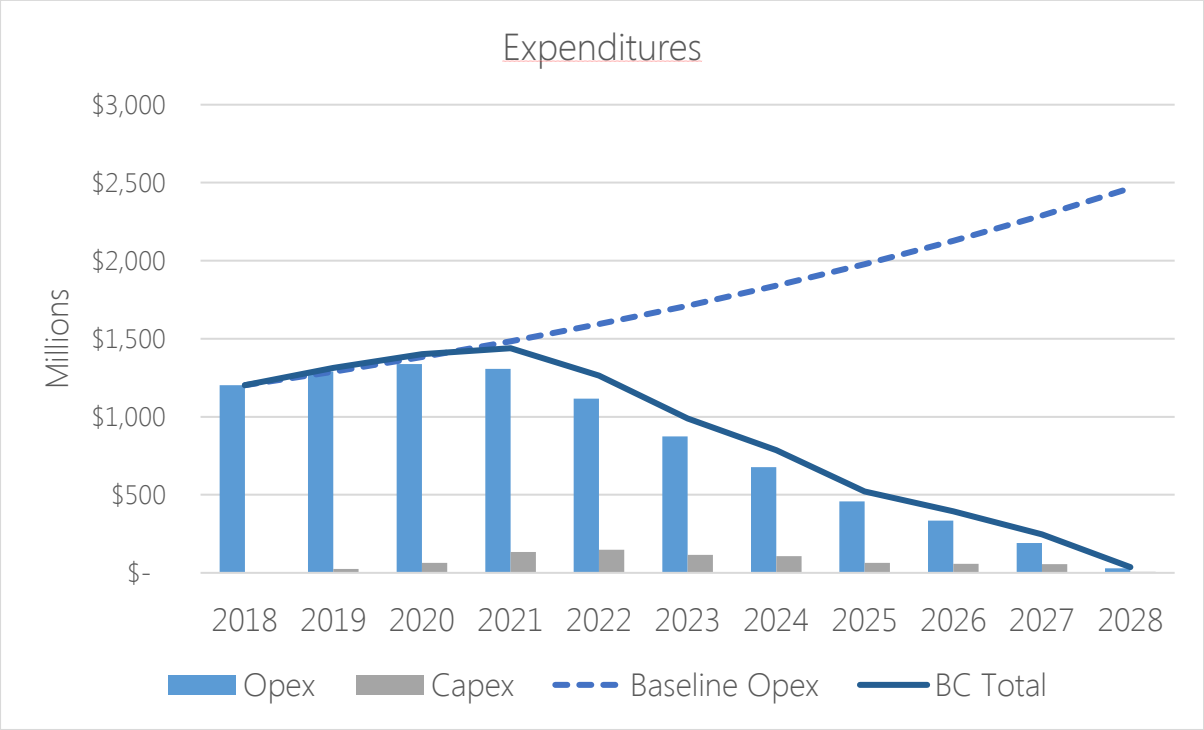


Table 7: Financial projections for XML

Year	Opex ($m)	Capex ($m)	Baseline Opex ($m)	BC Total ($m)	Net Benefit ($m)
2018	1203	0	1203	1203	0
2019	1290	24	1289	1314	-25
2020	1337	65	1383	1402	-19
2021	1306	133	1484	1439	45
2022	1116	148	1593	1264	330
2023	873	116	1712	989	723
2024	678	107	1840	785	1055
2025	458	64	1978	522	1457
2026	336	58	2128	393	1735
2027	192	55	2290	247	2043
2028	30	7	2465	37	2429