Domestic and International Passenger Integration in Airport Terminals

Unlocking Benefits of Mixed Terminals with Biometric Solutions

Contents

Executive Summary

This booklet was written as part of the Domestic and International Passenger Integration Program (DIPIP) to inform industry stakeholders, governments and regulatory bodies of the potential benefits from removing the physical segregation between international and domestic passengers in airport terminals, through the adoption of biometric technology.

Many airports across the world today maintain separate processing facilities for departing domestic and international passengers to comply with security and immigration regulations. This physical segregation, however, often leads to inefficiencies, increased operational costs, and disruption in passenger journeys.

Biometrics have been successfully adopted across the aviation industry, and IATA supports the use of this secure and efficient technology to develop solutions to enable the removal of the physical separation between domestic and international passengers. There are several different biometric solutions available to stakeholders, ranging in maturity and scale, which allow for seamless integration of passenger flows.

Domestic and international passenger integration has huge potential benefits. Enhanced travel experience, increased sustainability and efficiency of operations, as well as monetary savings and future cost reductions, could all be achieved through optimization of existing airport infrastructure.

This booklet provides an evidence-based justification for domestic and international passenger integration across various regional contexts globally. Using an impacts framework and different airport case studies as examples, it highlights the benefits that can be achieved and the solution concepts to consider. The focus is on departing passenger flows, in particular.

IATA's recommendation is that, by leveraging biometric technologies, airports can eliminate the need for physical segregation between domestic and international passengers. Airport stakeholders would create more flexible terminal spaces, enabled by secure and efficient technologies, allowing for the optimization of operations and a more seamless passenger journey. IATA believes this transformation will position airports, airlines, ground handlers and authorities to better handle future growth and evolving passenger expectations.

It is recommended that, as a first step, all stakeholders consider the impacts in their own context and conduct a cost-benefit analysis of the available solutions.

Context

This section provides an overview of the current context and presents the case for removing the physical segregation between domestic and international passengers.

Objectives

The objectives of this booklet are:

1. To provide evidence to justify the case for integrating domestic and international passengers in airport terminal buildings.
2. To identify solutions and provide implementation options to remove the physical segregation between domestic and international passengers in airport terminal buildings.
3. To identify high-level regulatory blockers to the mixing of domestic and international passengers.

Figure 1 - DIPIP Booklet Objectives

Why Domestic and International Passengers are Segregated

Domestic and international passengers have unique requirements, set by international and regional authorities, which are often written into aviation laws and regulations.

International passengers can be subject to extra security, customs and immigration checks to board an aircraft, whilst domestic passengers often require less documentation and security or baggage policies may come with fewer restrictions. Additionally, international passengers are often higher paying customers, so are typically offered a greater range of facilities and retail offerings (e.g., duty-free shops and currency exchange).

Passenger Flows Today

As a result of these requirements, the treatment of domestic and international passengers in airport terminal buildings varies hugely. Local contexts determine different designs for airport passenger terminals and set different security and immigration rules for coordinating passengers. The passenger journey experiences, therefore, are numerous.

Since there is so much variation across the world, a Use Case Model (UCM) was developed to organize different passenger flows in airport terminals into high-level common, logical groupings. Figure 2 illustrates the five use cases. Collectively, these cover most, but not all, passenger flows seen around the world today. Airports aligned to the same use case will share some characteristics but may have different passenger flows due to operational and regional factors.

Transfer passengers are assumed to be present across all use cases, although the volume and scale of transfer passenger flows varies from airport to airport.

The Assessment Approach section provides further details on and the rationale for the UCM.

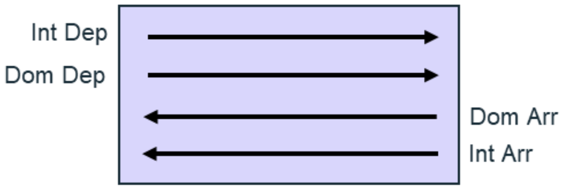
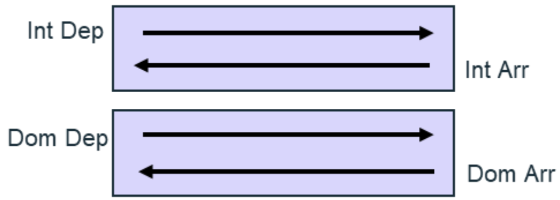
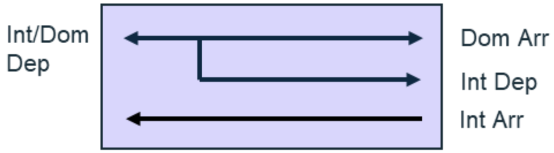
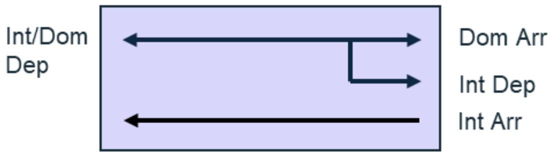
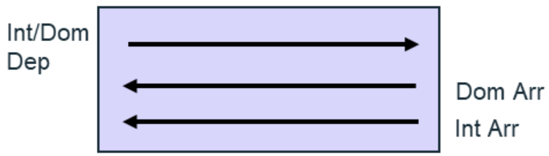
Airport Use Case (UC)	‘Existing’ Passenger Segregation on Departures	Use Case Description
1 **Airport with completely separate International and Domestic flows in a single terminal**		Represents airports with completely separate international and domestic passenger flows in a single terminal building. This context can be found in different regions around the world, typically at airports with a significant volume of passenger traffic and typically a significant share of transfer passengers. All passenger flows are segregated horizontally or vertically. This form of physical segregation is currently present at airports such as Beijing Daxing International Airport.
2 **Airport with separate International and Domestic terminals**		These are airports with separate international and domestic passenger terminals and, in many cases, a lower share of transfer passengers. This method of physical passenger segregation can be observed in various regions across the world, particularly those with different security screening and/ or operational requirements for domestic and international passengers. Airports in Australia, such as Sydney Airport, and airports in New Zealand, such as Auckland Airport, fall under this category.
3 **Airport with Domestic and International passenger segregation pre security**		These are airports where departing and arriving domestic passengers mix, whilst international passengers are segregated from domestic passengers pre-security, and with horizontal or vertical passenger flows. Arriving international passengers, however, are typically kept segregated. This method of separation is found at certain European Schengen country airports such as Athens Airport, and at several regions around the world including Africa and the Middle East.
4 **Airport with Domestic and International passenger segregation at pier**		These are airports where departing and arriving domestic passengers mix, whilst international passengers are segregated from domestic passengers at the pier, and with horizontal or vertical segregation of passenger flows. However, arriving international passengers are kept segregated. This physical passenger segregation strategy is most prominent in European Schengen country airports such as Brussels Airport and Geneva Airport, however it can also be found in other regions such as Asia Pacific (Mumbai Airport Terminal 2).
5 **Airport with no outbound passport control**		Use Cases 1 to 4 cover airports which need to physically segregate outbound passengers at varying points. This is because of the need to undertake outbound passport checks and to keep those passengers separated from domestic flows that are not subject to these checks. Use Case 5 represents airports with no outbound passport control. There are certain countries which have removed the physical segregation of departing domestic and international passengers already, however, segregation is still present for arriving passengers. This can be seen in the UK at London Heathrow Airport (Terminals 2 and 5). These examples are included to illustrate what airports look like once passengers are integrated.

Figure 2 – Use Case Model (UCM)

Passenger Flows in the Future

DIPIP envisages a convergence of flows at airports in the future where passengers will mix throughout departure facilities until they board their flight regardless of their destination. This convergence of flows will remove the need for the variety of use cases presented above to describe the flows we see today.

These consistent airport layouts and experiences will be enabled by biometric technologies which distinguish between passengers allowing stakeholders to carry out the checks they need to on international passengers before they travel. This logical, rather than physical, segregation will see passengers enroll themselves in the biometric system, validating their travel documents if necessary and freely mixing in the terminal before undergoing a reconciliation at boarding. This reconciliation will confirm that they are the enrolled passenger and have been appropriately processed to travel.

The equipment and process maturity will vary depending on the level of investment, ambition and stakeholder buy-in. Three solution concepts at varying levels of maturity are detailed later in this booklet.

Case for Change – The Benefits

There are several common business needs across airport stakeholders, which drive the removal of physical segregation between domestic and international passengers:

Improved Passenger Experience: it is expected that simplifying passenger journeys will enhance overall passenger experience, likely leading to greater passenger satisfaction. In combining domestic and international passengers, journey times and distances may reduce, and passenger confusion about navigation and wayfinding will lessen.

Cost Savings: reducing the need for separate facilities and infrastructure for domestic and international passengers will lower costs associated with maintenance, operations and construction. Maintaining physical passenger boundaries today requires airports to build separate facilities, power and supply utilities to separate areas, and resource multiple operations. The associated costs could be significantly reduced should facilities be combined.

Increased Capacity and Efficiency: by integrating domestic and international passenger flows, airports can optimize the use of terminal space and serve more passengers without the need for expansion. The capacity of many terminal buildings today is constrained due to passenger segregation and facilities are often underutilized during off-peak periods. By removing physical segregation, passengers can be combined into the same facilities and terminal areas can be used more flexibly particularly where peaks are asynchronous. Extra headroom can be created for growth within the existing infrastructure because higher volumes of passengers can be served within the same terminal footprint. This also reduces the costs required for future investment in additional infrastructure.

Increased Revenue: the ability to optimize flight schedules and use of terminal space may mean that the number of flights and passengers increase, with the possibility of improving the variety of routes available to customers. Additionally, passenger travel times through terminal processing facilities may decrease, meaning that passengers will spend more time in dedicated retail areas where domestic passengers will have access to greater service offerings, and overall attractiveness of air travel may improve.

Sustainability: aviation is under increasing pressure given its environmental impact. Consolidation of infrastructure and facilities could lead to energy efficiencies and reduce operational and construction-related carbon emission, aligning with the sustainability goals of many stakeholders.

Digitization: as confidence in and applications of technology increase, many airport stakeholders are favoring digital solutions. Biometrics offer a viable alternative to paper-based, manual processes used at many checkpoints in the passenger journey today. The technology keeps security at the heart of design, whilst also being faster, reducing human error and enabling capture of an increased amount of operational data.

Operational Flexibility: shared passenger facilities would enable airports, airlines and ground handlers to more easily manage fluctuating volumes of passenger traffic. Resources and equipment can be deployed more quickly to surges in passenger numbers when used efficiently in multi-purpose areas.

Competitive disadvantage for airline operations: As integration becomes more commonplace, there will be a competitive disadvantage to airlines operating at airports and terminals that maintain physical segregation.

To achieve the desired future state, a robust understanding of the impacts of integration and the solutions available is required. These are explained in further detail in the Solutions and Implementation section of this booklet.

There are enormous potential benefits associated with integrating domestic and international passengers that cover a wide range of areas and stakeholders, as outlined in Figure 3. Further details on these are provided in the Impacts section of this booklet.

Figure 3 - Benefits

Assessment Approach

IATA and AtkinsRéalis carried out an extensive scoping exercise to develop an Impacts Framework and identify the benefits and disbenefits of integration.

Stakeholders were then identified to prepare for consultation, which aimed at 1) validating the Impacts Framework, and 2) collecting data suitable for assessing the impacts. Ensuring coverage of different regional contexts around the world, the main stakeholder groups engaged were:

- Airports
- Airlines
- Ground handlers
- Border control authorities

Data was initially collected through questionnaires and a series of interviews were organized to follow-up and substantiate the findings. The data was then sorted and input into calculations to quantify the impacts, which industry experts at IATA and AtkinsRéalis validated. Quantitative analysis of each impact was completed and, in cases where limited data was available, a qualitative assessment was formed, primarily through stakeholder experience or research. The findings of the impact analysis are presented in this booklet.

At the same time as stakeholder consultations took place to assess the impacts, industry experts at AtkinsRéalis collated data on potential different biometric solutions. Solution concepts and a high-level implementation roadmap were then produced for airports, airlines and authorities to consider.

The flow chart below provides an overview of the approach followed:

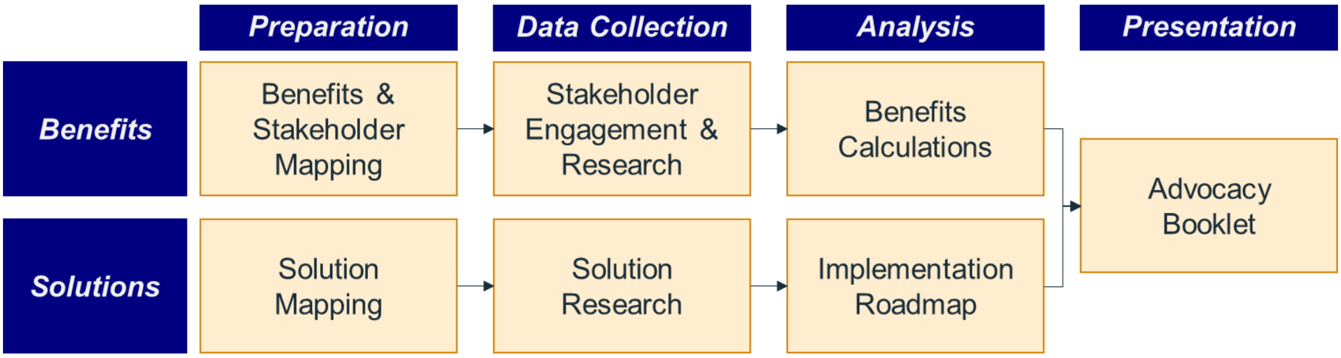


Figure 4 - Project Approach Flow Diagram

The following sub-sections provide additional detail on each stage of the approach.

Impact and Stakeholder Mapping

To effectively assess the impacts, the scale of each potential benefit and disbenefit needed to be determined. A logical methodology for making sense of the breadth of the global scale was, therefore, required. Three key activities took place to organize and rationalize the variation of impacts in different contexts from around the world:

- A Use Case Model (UCM) was developed to categorize 'as-is' airport contexts.

- Different stakeholders impacted were identified and grouped into the following categories: 1) Airports, 2) Airlines, 3) Ground Handlers, 4) Authorities, 5) Staff, and 6) Passengers.

- A series of assumptions and critical concepts were developed to define the scope of assessment. The key assumptions are explained in the Context section of this booklet.

Use Case Model (UCM)

The UCM introduced in the Context section of this booklet is used as a tool to 1) measure the impact of integration from different 'as-is' starting points, and 2) support the diverse, global audience considering the impact assessments in their own context.

The UCM also allowed mapping of benefits and disbenefits into an Impacts Framework, in which the scale of impact (High Benefit to High Disbenefit) to each stakeholder in each use case was determined.

Impacts Framework

The Impacts Framework classifies the impact of removing passenger segregation per stakeholder group and use case.

A long list of impacts was mapped onto a matrix by use case, stakeholder group, and benefit type (e.g. OPEX, CAPEX etc.). A five-point ranking scale was then applied to each individual impact to determine the significance, as detailed in the table below:

Table 1 - Impacts on Use Cases Ranking Scale

DARK GREEN - High Benefit	***High Benefit***	*Significant gains to be realized over multiple years from the operational change.*
LIGHT GREEN - Medium Benefit	***Medium Benefit***	*Sizeable gains to be realized over multiple years from the operational change.*
BLUE - Low/ No Impact	***Low/ No Impact***	*Upfront gains and cost implications of the operational change over 1-2 years.*
AMBER - Medium Disbenefit	***Medium Disbenefit***	*Sizeable upfront costs and implications from the operational change over multiple years.*
RED - High Disbenefit	***High Disbenefit***	*Significant upfront costs and implications from the operational change over multiple years.*

Figure 5 below is a simplified version of the Impacts Framework for both Brownfield and Greenfield sites. Having separately scored the scale of each individual impact, the figure displays the average scale of assessed impacts in each high-level category.[1]

[1] Impacts were scored on a scale of 1-5 (1 = High Disbenefit, 5 = High Benefit) and the mean average was calculated in each stakeholder and use case category. Decimal averages were rounded up to the nearest integer. The colours in the matrix correspond with the average impact. More significant individual impacts (higher benefit or higher disbenefit) will be present in each category. The breakdown of impacts is explained in detail in the Impacts section of this booklet.

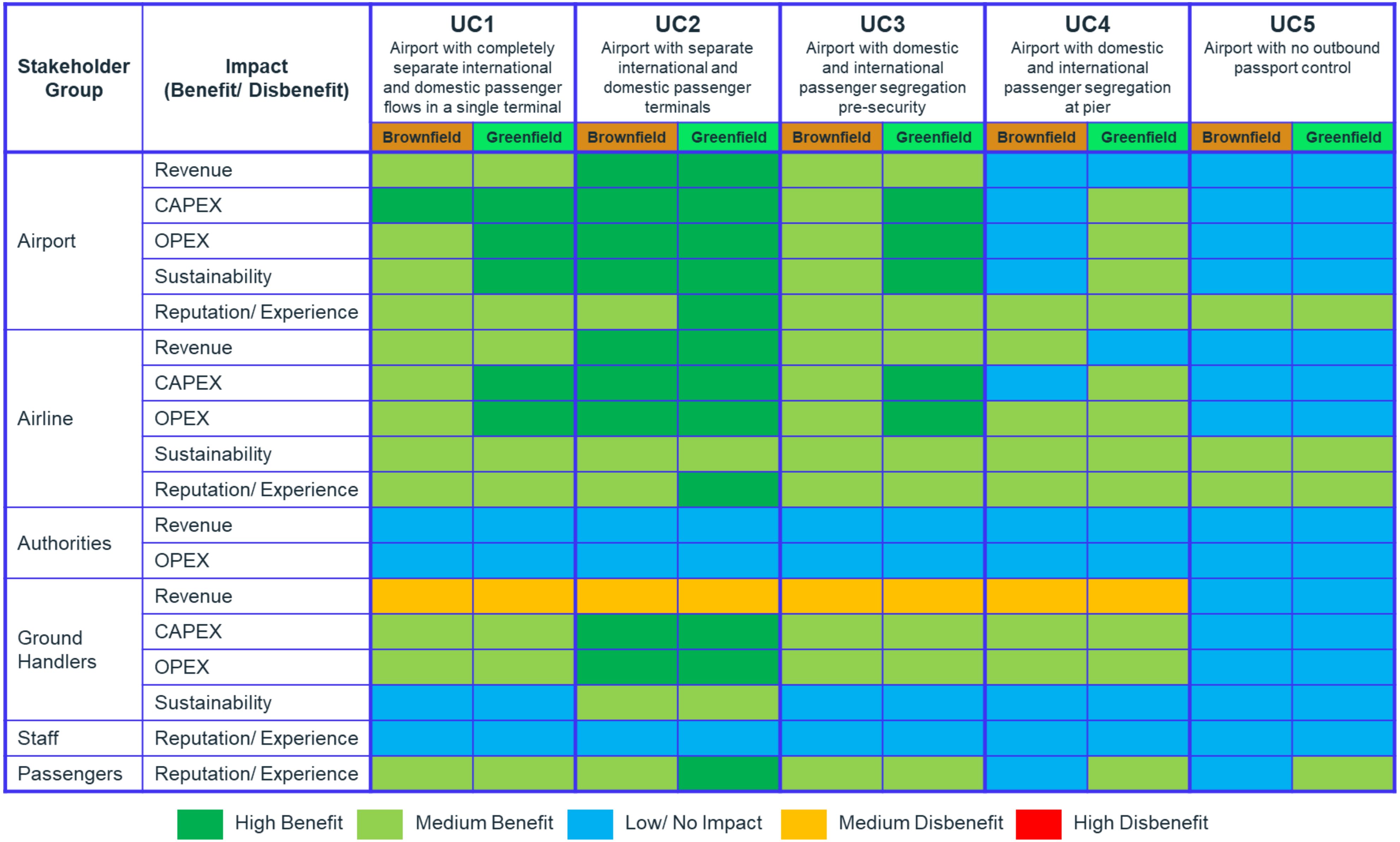


Figure 5 - High-Level Impact Scoring Matrix for Brownfield and Greenfield Sites

Greenfield sites show an increase in level of scoring across some of the use cases, notably in the following areas:

- **CAPEX benefits** are expected to be higher for greenfield sites as future airports or terminals would be designed and developed with a starting assumption of integrated operations, maximizing shared facilities. Furthermore, greenfield sites would not need upfront CAPEX to retrofit areas to facilitate shared use.

- **OPEX benefits** for greenfield developments starting with an assumption of mixed flows should lead to an efficient operation, both in terms of performance and number of staff required. Efficiencies will be more easily unlocked for new facilities where capital spend has not been committed already and long-term contractual arrangements are not already in place incurring on-going operational expenditure. Hence, the OPEX benefits for greenfield developments are expected to be higher.

- **Sustainability benefits** for a new facility, rather than retrofitting an existing facility, should similarly be higher through the development of new carbon efficient infrastructure and materials whilst maximizing the use of shared facilities.

- **Reputation benefits** for airports under UC2, where separate international and domestic facilities exist, are expected to be higher for greenfield sites as domestic and international passengers are more likely to be integrated under one roof, whilst for retrofitted brownfield sites, domestic and international facilities might still need to be segregated to some extent due to capacity constraints.

Stakeholder Engagement & Research

Selected stakeholders and industry experts in airport planning and development first validated the Impacts Framework:

- **IATA Airport Infrastructure and Customer Experience Teams**: This involved a discussion to better understand IATA's One ID initiative and its enablers, namely biometric solutions.
- **International Airline based in Oceania:** The benefits to the removal of physical passenger segregation were identified and validated from an airline perspective.
- **Airport in Europe:** This involved learning about biometric technologies and trials at the airport, as well as identifying and validating benefits to integration from an airport perspective.

Questionnaires and interviews were then conducted with a range of stakeholders to gather the data required to quantify and assess the impacts. A total of 39 stakeholders from 16 organizations were consulted, as depicted in the table below. Many of these stakeholders were also able to speak about the perceived impacts on staff and passengers, although no operational staff nor passengers were directly engaged as part of this exercise.

Table 2 – Stakeholders Consulted by Grouping

Stakeholder Group	Number of Stakeholders Engaged	Key Roles
Airports	13	▪ Airport Operations ▪ Senior Leadership ▪ Engineering ▪ Support Facilities ▪ Project Management ▪ Capacity Planning & Forecasting
Airlines	16	▪ Infrastructure & Strategy Planning ▪ Senior Leadership ▪ Airport Services ▪ Fleet Planning/ Management ▪ Security/ Governance ▪ Ground Operations ▪ Customer Experience ▪ Sustainability
Ground Handlers	3	▪ Customer Experience ▪ Ground Services/ Operations
Authorities	16	▪ Senior Leadership ▪ Biometrics ▪ Carrier Liaison ▪ Research ▪ Policy/ Legal
Total	**39**	

Engagement was supplemented by independent research into the impacts by AtkinsRéalis.

Solution Mapping & Research

In parallel to the stakeholder consultation, work on defining enabling biometric solutions and preparing implementation guidance took place. Industry-leading examples were researched, providing important considerations for future implementations.

Three solution concepts below were created to reflect different levels of technological maturity and operational readiness. Further details are provided in the Solutions section.

A roadmap was developed to outline the considerations stakeholders should make between project initiation and live operation to implement potential solutions. Research was also conducted into the initial CAPEX costs of deploying biometric technology to inform stakeholders about investments required.

Benefits Calculations

The data sourced through stakeholder engagement and research was used in a series of calculations to quantify each impact. Generally, the calculations projected anticipated cost reductions, improvements, or savings based on the latest data supplied from aviation stakeholders at brownfield sites.

The Case Studies section presents results from the calculations conducted on each impact assessed. For consistency and simplification, figures are rounded, and stakeholders have been anonymized. For impacts without reliable or available data from stakeholders, qualitative evidence is provided.

Data was received from different stakeholders at airports aligned to each use case. Two different example airports from separate regions were used to represent UC2 (airports with separate domestic and international terminals), which is why two UC2 case studies are presented.

The calculations are illustrative only and readers should not directly take the results to demonstrate realizable benefits in other situations without first undertaking work to understand your own context.

All financial figures are presented in 2024 USD ($) throughout.

Impacts of Domestic and International Passenger Integration

This section shows the potentially significant impacts from removing domestic and international passenger segregation in airport terminals. Further quantitative and qualitative observations, based on data from real-world examples, are presented in the case studies section.

Combined Passenger Impact Ratio (CPIR)

The Combined Passenger Impact Ratio (CPIR) is a formula used in many of the impact calculations. It is a tool to estimate the potential spare passenger processing headroom, as a result of non-coinciding peaks.

The CPIR is calculated through a flight schedule analysis of domestic and international departures at a specific airport. The combined number of domestic and international passengers in the peak hour is divided by the sum of the separate domestic peak hour passengers and international peak hour passengers, as illustrated below:

$$CPIR = 1 - \left(\frac{combined\ DOM\ INT\ pax\ in\ peak\ hour}{(DOM\ peak\ hour +\ INT\ peak\ hour)} \right)$$

Figure 6 - Combined Passenger Impact Ratio Calculation

For example, as depicted in Figure 7 below, if an airport has a combined domestic and international peak of 1,000 passengers, a domestic peak of 600 passengers, and an international peak of 700 passengers, the CPIR would be 0.23 (23%). There would be a 23% spare headroom for potential growth at that airport.

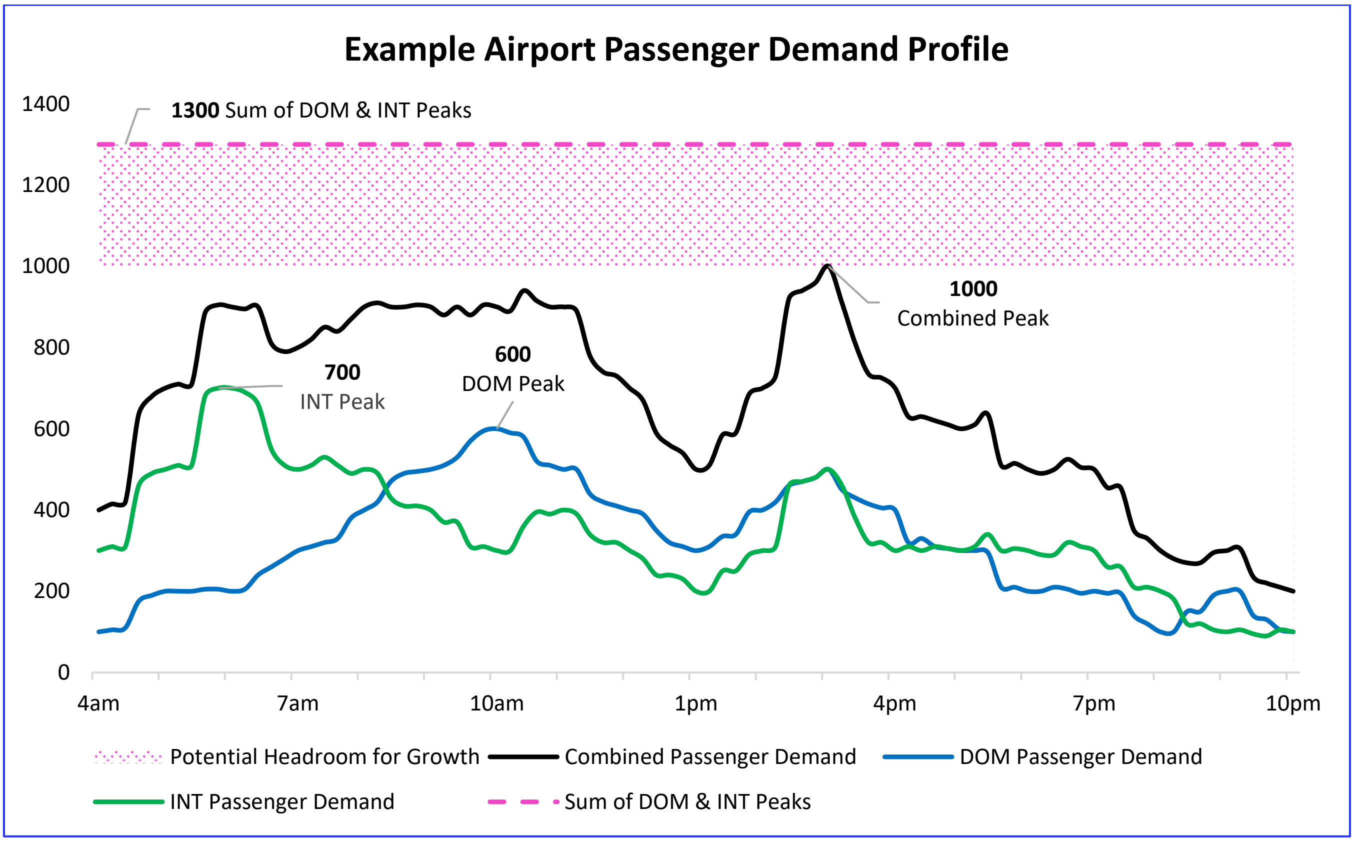


Figure 7 – Example Airport Passenger Demand Profile

The CPIR value is written as a percentage (%) saving and is dependent on current international and domestic peaks happening at different times of the day (i.e. not overlapping). If the peaks did overlap, the combined passenger peak hour would be the larger figure and there would likely be no headroom for the airport to increase operating capacity.

The CPIRs used in this booklet are based on real-world flight schedule data supplied by each example airport and represent the potential headroom for growth. The CPIRs range from 6% to 34% because flight schedules vary on a case-by-case basis. Values outside this range are possible in other airports.

Since the potential headroom for growth will be different at each airport, any stakeholder looking at their own specific case will need to identify if there is any potential headroom and how it could be used. It is recommended, therefore, for the CPIR to be calculated individually for each airport considering passenger integration.

The CPIR forms part of several of the benefits calculations used, such as CAPEX estimates for quantifying the potential headroom for growth within existing terminal infrastructure. It is also associated with reductions in OPEX (e.g., staffing and utilities) and sustainability calculations (e.g. operational carbon savings). It can be applied across multiple calculations to quantify potential savings because an outcome of removing passenger segregation is that terminal areas are shared and use of the space, equipment and facilities is, therefore, optimized.

CAPEX Impacts

There are several significant Capital Expenditure (CAPEX) benefits to removing of domestic and international passenger segregation in airport terminals. There are also the upfront CAPEX costs associated with implementation of solutions. The following section explains, quantifies, and analyses the different CAPEX impacts.

Explaining the CAPEX Impact

CAPEX refers to the funds used by an organization to acquire, upgrade, and maintain physical assets or equipment. Future CAPEX reductions, resulting from the removal of domestic and international passenger segregation, are primarily derived from the extra capacity, or headroom, created by being able to better utilize current assets and equipment. Essentially, the same number of passengers served by airports with passenger segregation today could be served using less terminal floorspace and equipment in integrated passenger terminals. The existing infrastructure can be optimized (i.e., less space is required) to serve current demand.

This extra capacity, therefore, unlocks headroom for an airport to grow before needing to build new infrastructure. With global passenger demand set to increase, domestic and international passenger integration is a great and affordable way to achieve extra capacity.

The opportunities that come with creating extra capacity for future growth do not just apply to the physical terminal buildings. The same could be true for bussing and towing Ground Support Equipment (GSE), following a reduction in the number of movements required from integration, in comparison to the movements required for segregated passengers. Another area that could be impacted by extra capacity is aircraft stands, as there would be greater flexibility from more bi-status stand usage made possible through integration. Additionally, there could be future CAPEX reductions related to equipment used in different processing facilities once areas are integrated and become dual purpose. Reducing future CAPEX on security screening equipment that would serve both domestic and international passengers together is a good example. The opportunity even extends to airlines, who could experience downstream savings on aircraft fleet when consolidating fleet operations and optimizing capacity within their existing fleet. Therefore, when considering how existing infrastructure can be optimized, a potential reduction in CAPEX is applicable to airports, airlines and ground handlers.

It should be noted that there would be an upfront CAPEX cost required for the procurement and implementation of biometric technology to enable integration in the first place. The costs would depend on several factors, such as the maturity of the chosen solution and number of touchpoints required, but this would only be incurred in the short-term. Additional CAPEX may be required for the internal reorganization of existing facilities and spaces.

Since CAPEX is intrinsically tied to the built environment, the scale of CAPEX benefit depends heavily on the size and scale of existing infrastructure. Larger, more segregated, or less efficient airports have a greater opportunity for optimizing current assets and equipment. For those reasons, UC4 airports would experience less benefit because passenger segregation only occurs at the piers, so there is less initial space and fewer initial assets to build extra capacity into. Alternatively, there would likely be greater benefit for stakeholders in UC2 airports because whole terminals are currently segregated and there are longer distances between domestic and international facilities, making the handling of domestic and international passengers less efficient.

The figure below displays the estimated CAPEX impacts across use cases and stakeholder groups:

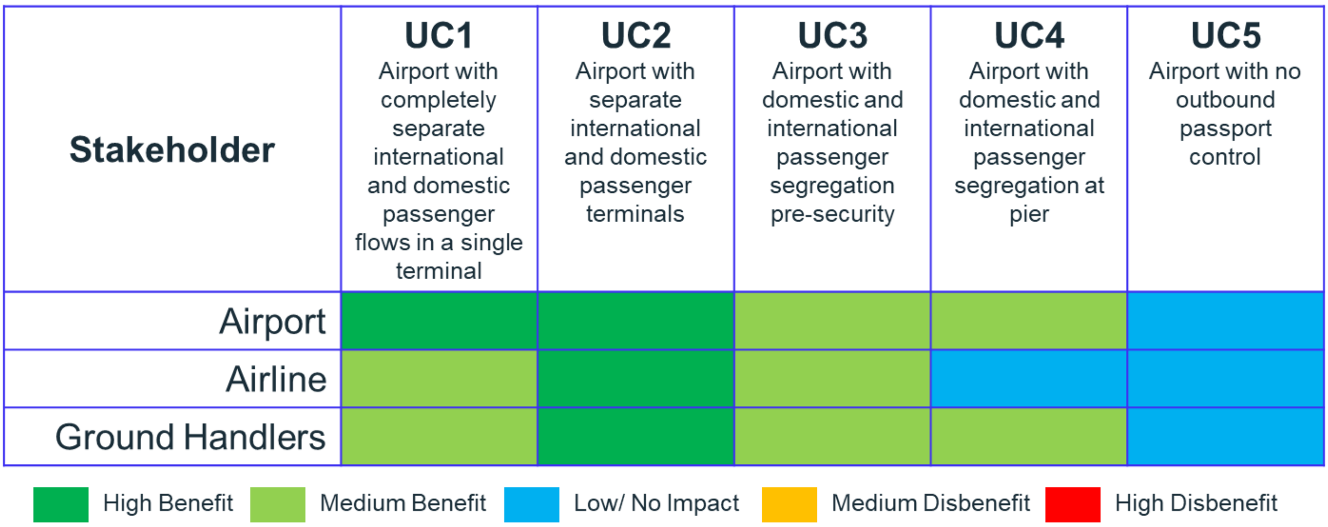


Figure 8 – Estimated Impact on CAPEX for each Stakeholder

Assessed CAPEX Impacts

The following graph provides a summary of the observed CAPEX benefits calculated using data supplied by airports aligned to each use case.

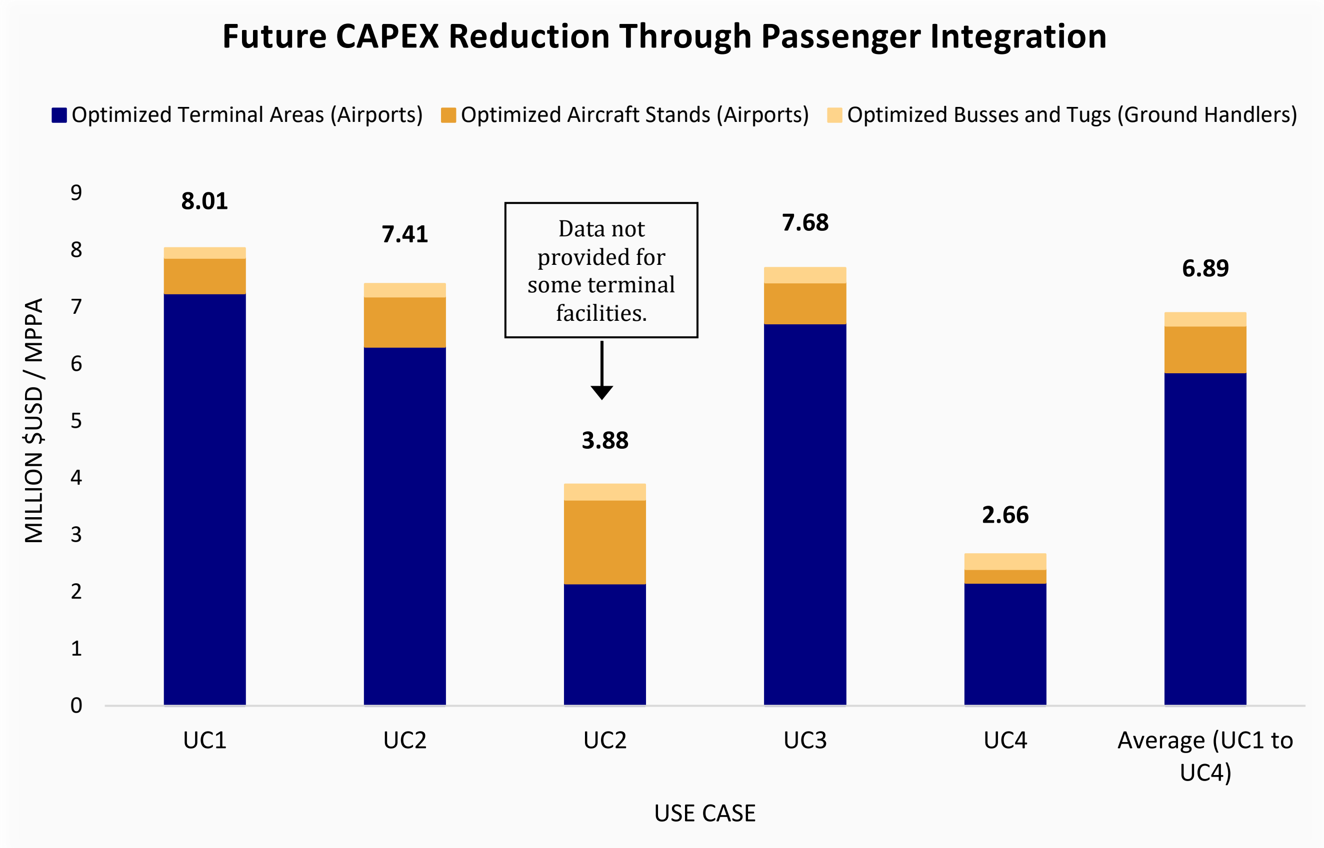


Figure 9 - CAPEX Impact Summary

A very significant CAPEX benefit is achievable to stakeholders through the optimization of existing capital made possible by passenger integration. There is therefore good reason for integration, especially for airports struggling with capacity constraints already. The UC4 airport displays the least potential benefit because segregation is only at the piers and gates. The scale of existing infrastructure is also a factor to consider when comparing the absolute savings across different use cases.

Solution Investment

To enable the removal of physical segregation and unlock all the benefits, an initial CAPEX investment is required to procure and implement biometric solutions. Guidance on the component costs, such as the physical equipment, installation and system integration, is presented below.

Whilst historically airports have incurred substantial costs to implement solutions, effectively subsidizing prototype development for vendors, today's biometric technology market has matured. With improved performance and broader adoption, scalable, affordable commercial models have emerged. As a result, CAPEX primarily centers on the procurement, installation and integration rather than on system development, with off-the-shelf solutions now available.

Every airport has unique requirements based on factors such as layout, passenger volumes, peak flow and service standards at touchpoints. Therefore, a standard budgetary figure cannot be universally applied. Instead, this guidance provides indicative costs on a per-unit basis, allowing airports to scale the guidance to their specific needs.

Stakeholders should consider these CAPEX estimates as high-level benchmarks, anticipating that a more detailed cost analysis will be needed for specific implementation projects. Localized feasibility studies and benefit analyses are essential to validating the investment.

The following indicative CAPEX estimates are derived from professional experience and consultations with vendors. They are identified as base unit rates in USD and use a Q4 2024 pricing base-date, with cost normalization across regions. They should be considered as an 'Order of Magnitude' representation, exclusive of any associated expansion, remodeling to terminal building and services, or Main Contractor indirect costs.

Table 3 – Solution CAPEX Rates for Guidance

Hardware Component	Unit Basis	Base Rates ($)	Total Rate ($)	Application Commentary
Desk Mounted Biometric Camera	Per touchpoint	Equipment: $5,000 Installation: $2,000	$7,000	Essential for basic biometric implementations, useful for Level 1 (L1) Maturity solutions or for contingency processes in advanced solutions.
Handheld Tablet/Camea	Per touchpoint	Equipment: $2,500	$2,500	Deployed primarily in traditional check-in and boarding processes and at exception points, offering flexibility without additional installation costs.
Self-Service Gate with Integrated Biometric Camera	Per touchpoint	Equipment: $25,000 Installation: $15,000	$40,000	Used at boarding and ticket touchpoints to enable self-service options within integrated passenger flows.
Border Gate	Per touchpoint	Equipment: $45,000 Installation: $25,000	$70,000	Biometric-equipped gates for immigration/emigration processes, including passport readers and cameras.
Software Component	**Unit Basis**		**Total Rate $**	**Commentary on Solution Application**
Software Configuration	Per touchpoint		$5,000	Ensures each touchpoint is configured for seamless integration with airline or authority systems.
System Integration	Per system owning stakeholder		$350,000	Assumes commercial off-the-shelf solutions are used rather than bespoke development. Integration aligns systems between airlines, airports, and authorities.
Training	Per staff member		$500	Provides one day of training for staff to operate and manage new systems effectively.

The values above include some exceptions regarding technology integration and procurement that should be considered. Integration with airline systems, development of border authorities' databases and different commercial model options are excluded. In addition, stakeholders should consider scalability planning and mixed commercial models when upfront investment is required.

CAPEX Impact Summary

Passenger integration could have the following CAPEX benefits:

- Reduced future CAPEX for airports by decreasing the current GFA requirements in terminal buildings, creating headroom for growth. Airports with a greater proportion of segregated terminal areas today will benefit most.

- Reduced future CAPEX for airports due to optimizing aircraft stands, by providing greater flexibility of movement for passengers in integrated terminals and the more flexible use of stands for domestic and international operations. Airports that currently have the greatest separation of domestic and international stands will receive the largest benefit.

- Reduced future CAPEX for ground handlers and airlines due to the optimization of bussing and towing movements, creating greater capacity in current GSE fleets. Stakeholders at airports requiring more bus and tow movements for segregation purposes today will benefit most.

- Reduced future CAPEX for airlines through opportunities to consolidate fleet operations and create capacity within existing aircraft fleet. Airlines which operate at airports with higher levels of segregation will benefit more.

Upfront CAPEX for airports will be required for the procurement and implementation of biometric solutions that enable the removal of physical segregation between international and domestic passengers. The maturity of the solution and the number of components will affect the potential cost.

OPEX Impacts

Removing the segregation between domestic and international passengers in airport terminals can lead to substantial Operational Expenditure (OPEX) savings. This section outlines, quantifies, and analyses these OPEX benefits in detail. Stakeholders are encouraged to assess the potential impact within their own operational contexts.

Explaining the OPEX Impact

The OPEX benefits of combining domestic and international passengers in airport terminals are probably the farthest reaching. There is a broad spectrum of OPEX impacts that can be achieved; anything from lower utilities and staffing costs for airports, to savings for ground handlers resulting from reduced staffing requirements for future bussing and towing operations. The benefits can be placed into two categories: 1) the removal of duplication (roles, utilities etc.), and 2) performance optimization. The scale of benefit is dependent upon circumstance, so each impact is assessed across different use cases and stakeholders.

For airports, removal of domestic and international passenger segregation results in reduction of staff needed to resource each terminal area. From once needing a fully resourced team to manage a separate area for domestic passengers, combined passenger flows can be served by fewer resources in a shared location. The same logic applies to power and water utilities as combined terminal areas will require less electricity, gas and water than segregated areas. This benefit would be achieved in addition to the reduction of future infrastructure requirements, but relies upon airports choosing to reduce, or turn off, the utility supply in any unused terminal areas. In UC3 airports there is no impact to either staff or utilities in check-in concourses because segregation only occurs after that point in the passenger journey. Similarly, there is only an impact for UC4 airports at the piers and gates, where segregation occurs. Typically, UC5 airports already have a fully integrated departures process.

For airlines OPEX benefits result from the reduction of staff, gate flexibility and stand optimization, as well as lower running costs. In terminal areas where airline staff are currently deployed (e.g., airline staff at check-in desks), duplicate roles can be removed for areas set-up to serve segregated passenger flows. The same is true at piers and gates, where there is an extra potential saving due to the flexibility of stands being able to handle bi-status flights and the reduction in operating costs associated with reduced roles and bussing required as a result. If a stand that once could only accommodate domestic flights can now also serve international services, there is room to reconfigure flight schedules to optimize the distribution of staff and reduce the need for bussing. Additionally, airlines would benefit from cost savings to aircraft fuel if on-time performance (OTP) and 'taxi-in' delays were improved. Aircraft could spend less time burning fuel on taxiways by not having to wait for a specific stand to become available due to segregation.

For ground handlers, combined passenger airport terminals would reduce OPEX costs by either removing duplicate ground handling roles or better utilization of GSE, or both. The number of busses and towing operations required to manage domestic and international segregation would significantly reduce and, with optimized schedules, would result in the potential to reduce staff and use fewer busses. There could also be opportunities to reduce fuel burn from buses and tugs, however these have not been included in the analysis due the number of electric vehicles already in use and the complexity of calculating this reduction as it is airport specific.

The figure below displays the estimated OPEX impacts across use cases and stakeholder groups:

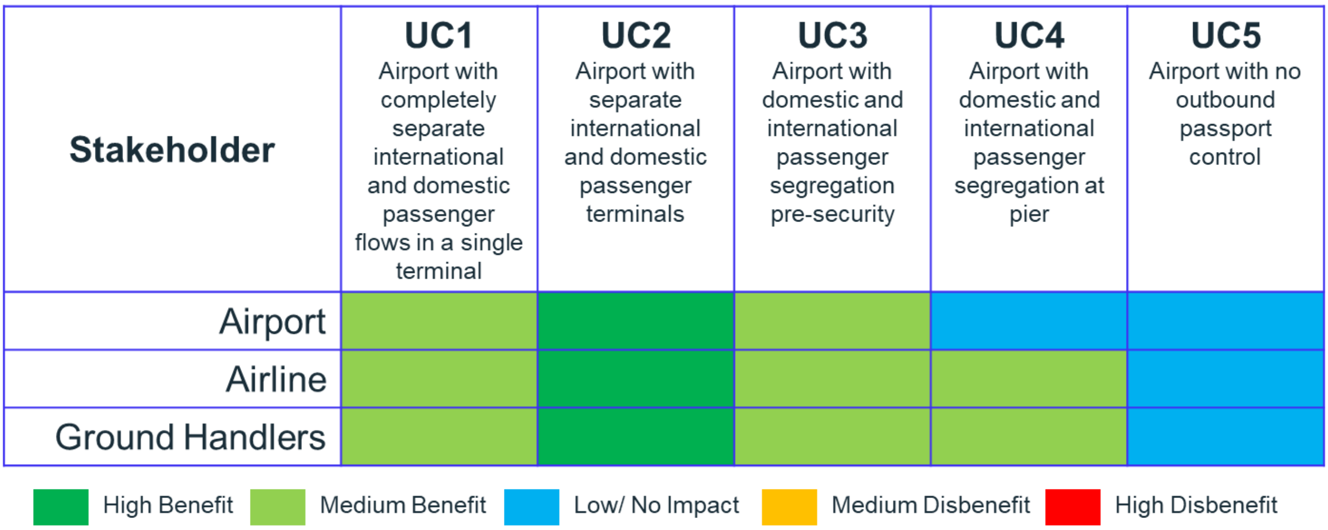


Figure 10 – Estimated Impact on OPEX for each Stakeholder

Assessed Annual OPEX Impacts

The following table provides a summary of the observed annual OPEX benefits calculated using data supplied by stakeholders aligned to each use case.

Table 4 – OPEX Benefit through Removal of Duplicate Processes

OPEX Benefit Description	UC1	UC2	UC2	UC3	UC4	Average (UC1 to UC4)
Airport Staff Efficiencies (% Reduction)	11%	6%	34%	23%	N/A	**18.5%**
Ground Handler Staff Efficiencies (Million $ USD)	1.0	*Staff OPEX efficiencies of 6-34%.*			5.3	**3.2**
Airport Energy Cost Reduction (Million $ USD)	4.4	3.4	0.9	0.7	0.3	**1.9**
Airport Water Cost Reduction (Million $ USD)	0.15	0.05	N/A	0.02	N/A	**0.07**
Total Quantified Annual OPEX Reduction (Million $ USD)	**5.5**	**3.5**	**0.9**	**0.7**	**5.6**	3.2

There are considerable annual OPEX savings available across all four use cases through the removal of duplicate facilities. As these are on-going cost reductions, passenger integration is something worth considering for all stakeholders. As expected, the benefits are greater in airports currently further from the 'end-goal' of integration. Other factors, such as regional staff costs, also impact the scale of absolute savings.

OPEX Impact Summary

Passenger integration could provide the following OPEX benefits:

- Reduced airport and ground handling staff costs due to the integration of domestic and international terminal operations. This benefit will be greater in airports where there is currently separation across a greater number of facilities.

- Reduced airport OPEX costs on utilities (e.g., electricity, gas, water) due to the integration of domestic and international terminal operations. This benefit will be greater in airports where there is currently separation across a greater number of facilities.

- Reduced airline OPEX costs from ground handling charges through the optimization of bussing and towing operations. This impact will be greater in airports that currently have a high proportion of bussing and towing movements to facilitate segregation.

- Reduced airline OPEX costs on fuel burn due to the reduction of 'taxi-in' delays caused by aircraft waiting for the correct specific domestic or international stand availability. This benefit will be greatest in airports that currently experience a high proportion of 'taxi-in' delays due to segregation.

Revenue Impacts

This section presents analysis on the potentially significant impacts to revenues for airports and airlines.

Explaining the Revenue Impact

Increased revenue could be generated through the removal of segregation by reducing MCTs from combined domestic and international passenger flows, benefiting both airports and airlines. Airlines will also benefit from reduced airport charges from the removal of duplicated facilities, as a result of integration.

The removal of physical barriers between domestic and international passengers, and the utilization of quicker biometric processing technology at passenger checkpoints, should reduce the MCTs required for transfer passengers. A reduced MCT would increase revenue because it makes travelling through airport terminals quicker for passengers, so additional passengers would choose that journey and overall passenger spend could increase. Airlines would directly benefit from more tickets being bought. Faster processing through check-in halls and shorter travel distances across the airport, for instance, may also mean more time spent in departure lounges and retail areas where passenger satisfaction is typically the highest.

The increase in passenger numbers travelling through retail areas within a shared terminal could result in increased spend per passenger as there would be exposure to different retail offerings for domestic and international passengers. The novelty of different outlets and the increase in choice may see domestic passengers, for instance, spend more than they normally would when faced with shops tailored solely to a domestic audience.

The benefit to revenue is expected to be largest for UC1, UC2 and UC3 airport stakeholders because of the greatest opportunities to reduce MCTs. UC4 airports would be less impacted because segregation happens after the shared retail facilities in departure lounges. Likewise, there is no impact for UC5 airports because departure lounges are usually already fully integrated.

Reduced CAPEX costs for future expansion of infrastructure will reduce the future investment needed from airlines. Additionally, fewer operational delays, and optimized bussing and towing, will result in better OTP and fewer charges imposed by airports.

Ground handlers, however, may experience a disbenefit in revenue. As the need for bussing and towing operations associated with current segregated operations diminishes, ground handlers are unlikely to generate revenue from charging for these services. Although, the lost revenue is dependent upon the scale of reduction, and whether ground handlers can be redeployed elsewhere. There could be fewer services to perform than there are today and any disbenefit would depend on how reliant they currently are on bussing and towing to move separated passengers around the airport, which is probably only a low proportion of their service remit. This might be offset by opportunities for staff efficiencies and the reduced CAPEX (highlighted in the previous section) enabled through integration.

Consideration of the impact of combined international and domestic retail on duty free offerings is important to highlight. Retailers will need to ensure domestic customers are not taking advantage of international rates and complying with duty free quantity limits which can vary by destination. It is, however, a passengers' responsibility to ensure they are compliant with customs guidance.

The figure below displays the estimated Revenue impacts across use cases and stakeholder groups:

Stakeholder	UC1 Airport with completely separate international and domestic passenger flows in a single terminal	UC2 Airport with separate international and domestic passenger terminals	UC3 Airport with domestic and international passenger segregation pre-security	UC4 Airport with domestic and international passenger segregation at pier	UC5 Airport with no outbound passport control
Airport	Medium Benefit	High Benefit	Medium Benefit	Low/ No Impact	Low/ No Impact
Airline	Medium Benefit	High Benefit	Medium Benefit	Medium Benefit	Low/ No Impact
Ground Handlers	Medium Disbenefit	Medium Disbenefit	Medium Disbenefit	Medium Disbenefit	Low/ No Impact

High Benefit · Medium Benefit · Low/ No Impact · Medium Disbenefit · High Disbenefit

Figure 11 – Estimated Impact on Revenue for each Stakeholder

Assessed Revenue Impacts

MCT Reduction

The following graph provides a summary of the observed potential reduction in MCTs calculated following stakeholder engagement:

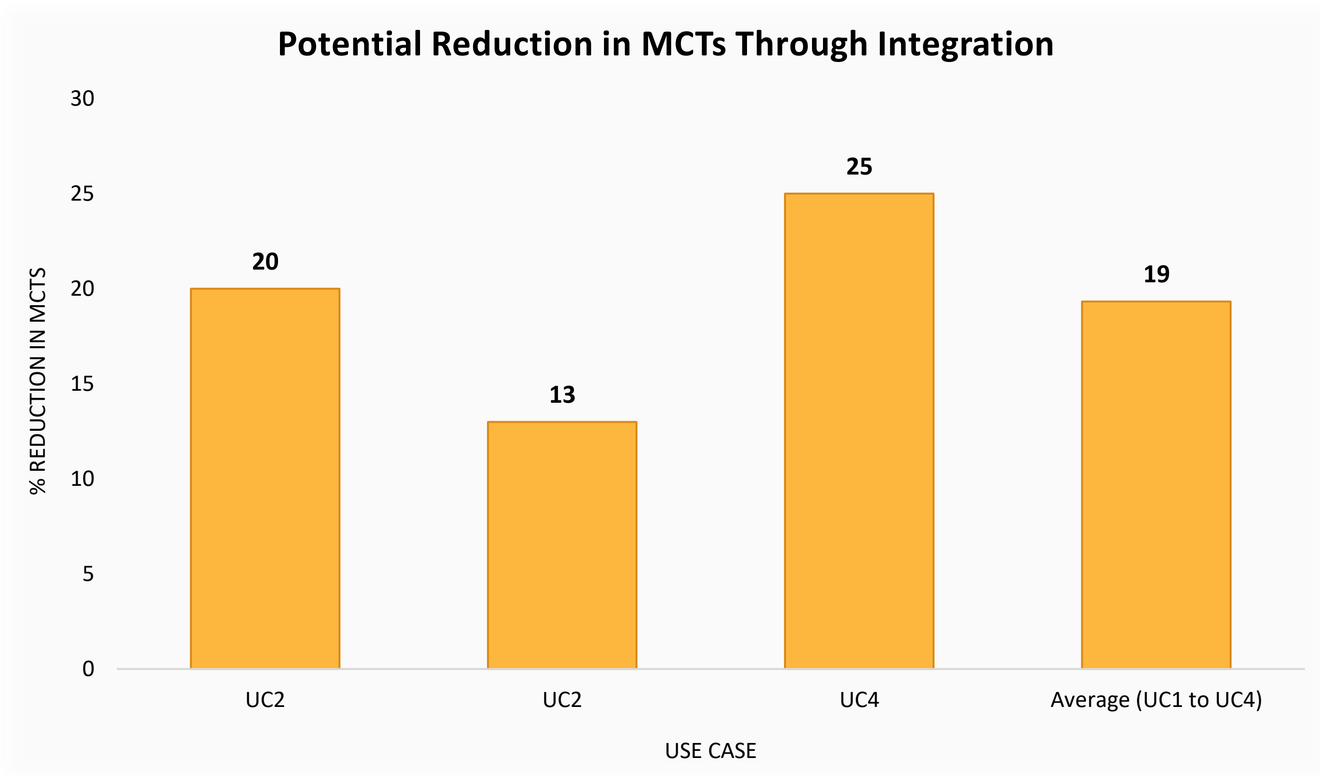


Figure 12 – Potential Reduction in MCTs

A significant reduction in MCTs could be achieved across all the assessed use cases. Integration should therefore be considered by airports, especially those currently experiencing long MCTs due to segregation.

Combining Passenger Flows

The data required to quantify the impact of combined passenger flows was difficult to source because several assumptions would have to be made on things such as current retail spend per passenger and the connection between passenger numbers and retail spend per passenger, which were not available.

Qualitatively, the response from stakeholders consulted was that combining passenger flows could increase retail revenue. The statements below were collated from stakeholders in different regions and corroborate the benefits of combining passenger flows:

- Revenue could increase from the removal of physical segregation because "*this could lead to increased spending per passenger*".
- The benefit would be greatest for domestic passengers because they would "*benefit from the greater variety of retail options typically available in international departure areas*".
- Higher passenger numbers in retail spaces "*can lead to higher sales volumes*".
- "*We anticipate that the removal of passenger segregation could increase retail revenue, as a result of greater footfall (combined passenger flows) and the greater retail offering to domestic passengers*."

Task Reduction

The number of bussing and towing movements required today to facilitate passenger segregation will effectively be removed. A revenue reduction for ground handlers, therefore, can be calculated by multiplying that number by the cost per movement.

The disbenefit is dependent on the volume of bussing and towing operations currently undertaken for segregation purposes. In some cases, there may still be a need to bus for international arriving aircraft, where an appropriate stand is unavailable, and for remote stands, for instance. Equally, the new time made available from reducing the bussing and towing operations may be easily diverted to other uses, allowing revenue to be maintained.

Revenue Impact Summary

Passenger integration could provide the following revenue benefits:

- Increased revenue for airlines and airports by reducing MCTs, airport charges, and improving OTP, due to greater flexibility in passenger journeys. Airports with high MCTs due to segregation will see the greatest benefit.

- Increased airport and airline revenue due to higher passenger flows and increasing retail offerings available to some passengers. The impact will be more significant in airports where there are currently separate domestic and international departure lounges.

- Potential decreased revenue for ground handlers as a result of reduced bussing and towing movements. The impact of this depends on the proportion of movements currently associated with segregation.

Sustainability Impacts

Passenger concerns about the sustainability of air travel are growing. Therefore, any initiative to reduce the carbon footprint of the passenger journey is a significant win, showcasing that airports and airlines are actively addressing their customers' concerns.

Explaining the Sustainability Impact

Embodied Carbon

Embodied carbon represents the total greenhouse gas emissions associated with the production, transportation, and assembly of building materials. Reducing embodied carbon is a key aspect of sustainable development, as it lowers the environmental impact of construction and infrastructure projects, thereby contributing to climate change mitigation and promoting a more resource-efficient future.

By removing the segregation of domestic and international passengers, terminal infrastructure can be better utilized to reduce GFA requirements of airports. For brownfield sites, it presents the opportunity to lock-in less embodied carbon for future capacity enhancement, or, in other words, opening the opportunity for capacity enhancement without necessarily increasing the embodied carbon footprint of the airport. For both greenfield and brownfield sites, depending on local and regional sustainability regulations and targets, this can be of great significance in meeting demanding greener practices and alignment to climate change goals.

It is however important to note that, for brownfield sites in the short-term, an increase in embodied carbon may occur through the process of removing physical segregation from retrofitting or construction activities.

As embodied carbon relates to terminal infrastructure and its building materials, there is no direct environmental benefit or sustainability impact to airlines, authorities, ground handlers, staff or passengers. Instead, non-environmental secondary benefits can apply. For airports and airlines this may contribute to enhanced reputation and stakeholder trust through improved public image, increased investor appeal and stronger airline and eco-aware passenger alignment. Stakeholders such as ground handlers and staff may have heightened workplace pride and morale when engaged in a workplace that is committed to making a positive environmental impact.

Operational Carbon

Operational carbon refers to the greenhouse gas emissions produced from the energy used to operate a building, such as a terminal, or a product, such as an aircraft, throughout its operational lifecycle. This includes the energy required for heating, cooling, lighting, ventilation, as well as powering systems and appliances.

For airport terminals, through better utilization of floor areas and, thus, consolidation of terminal space, saving opportunities for operational carbon are feasible through the removal of duplicate processes, facilities, and their resulting impact on utilities (energy and water usage) with the possibility of passengers indirectly contributing to this reduction. For other stakeholders, further knock-on impacts of terminal consolidation that result in reduced operational carbon include reduced fuel burn for airlines through better OTP. Aircraft could experience fewer 'taxi-in' delays waiting for the right status stands to become available, because integration allows for improved stand flexibility, and reduce total fuel burn as a result.

The figure below displays the distribution of sustainability impacts across use cases and stakeholder groups:

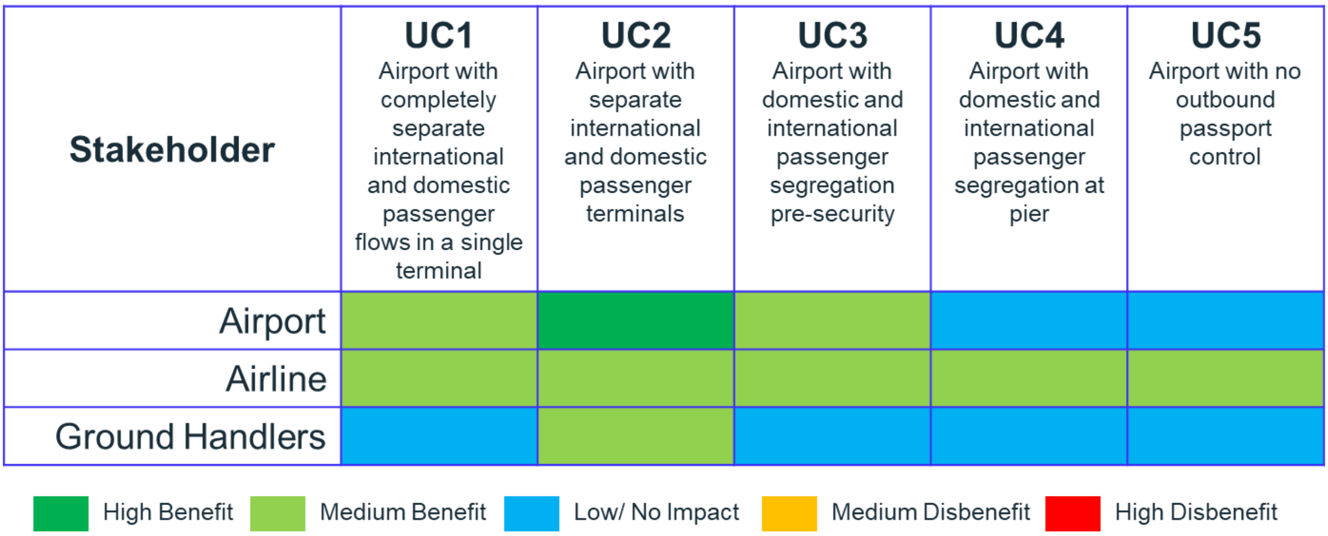


Figure 13 – Estimated Impact on Sustainability for each Stakeholder

Assessed Sustainability Impacts

The figure below summarizes the observed potential reduction in embodied carbon for airports per MPPA through the different airport use cases. On average, airports could reduce future carbon emissions by up to 1 million kgCO_2e per MPPA. This assumes no construction is required for the removal of physical segregation.

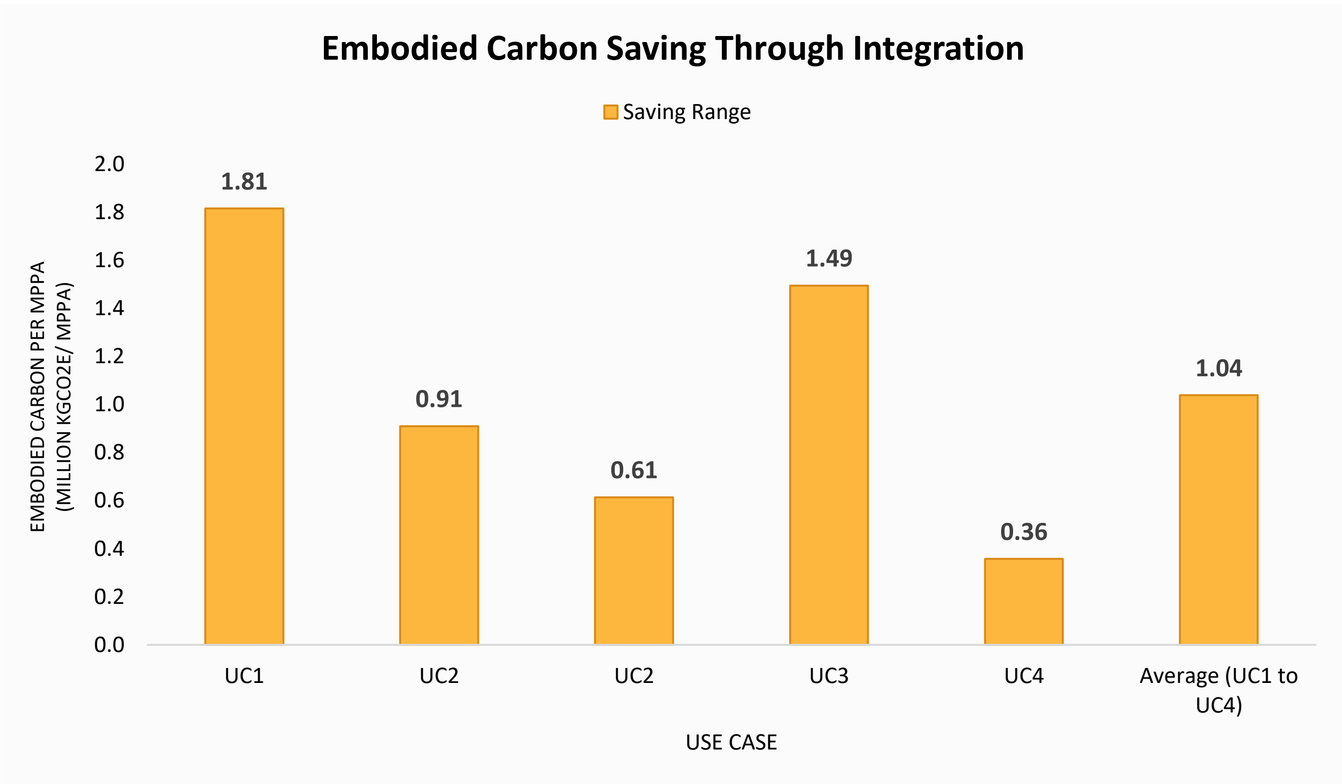


Figure 14 – Airport Embodied Carbon Savings per MPPA

As expected, airports closer to the 'end goal', like UC4, have the least potential to reduce embodied carbon in their journey towards allowing passenger integration. Other factors, however, also play a part in determining the scale of impact. For instance, UC3 has a higher range of potential embodied carbon savings than UC2, despite being integrated in more areas than the UC2 airport. This is because it has a larger airport footprint. Size differences allow for larger terminals to realize a bigger saving in absolute figures.

The figure below summarizes the observed potential annual operational carbon savings per MPPA from reduced electricity consumption that is achievable through integration. On average, airports can save up to 230,000 $kgCO_2e$/ MPPA.

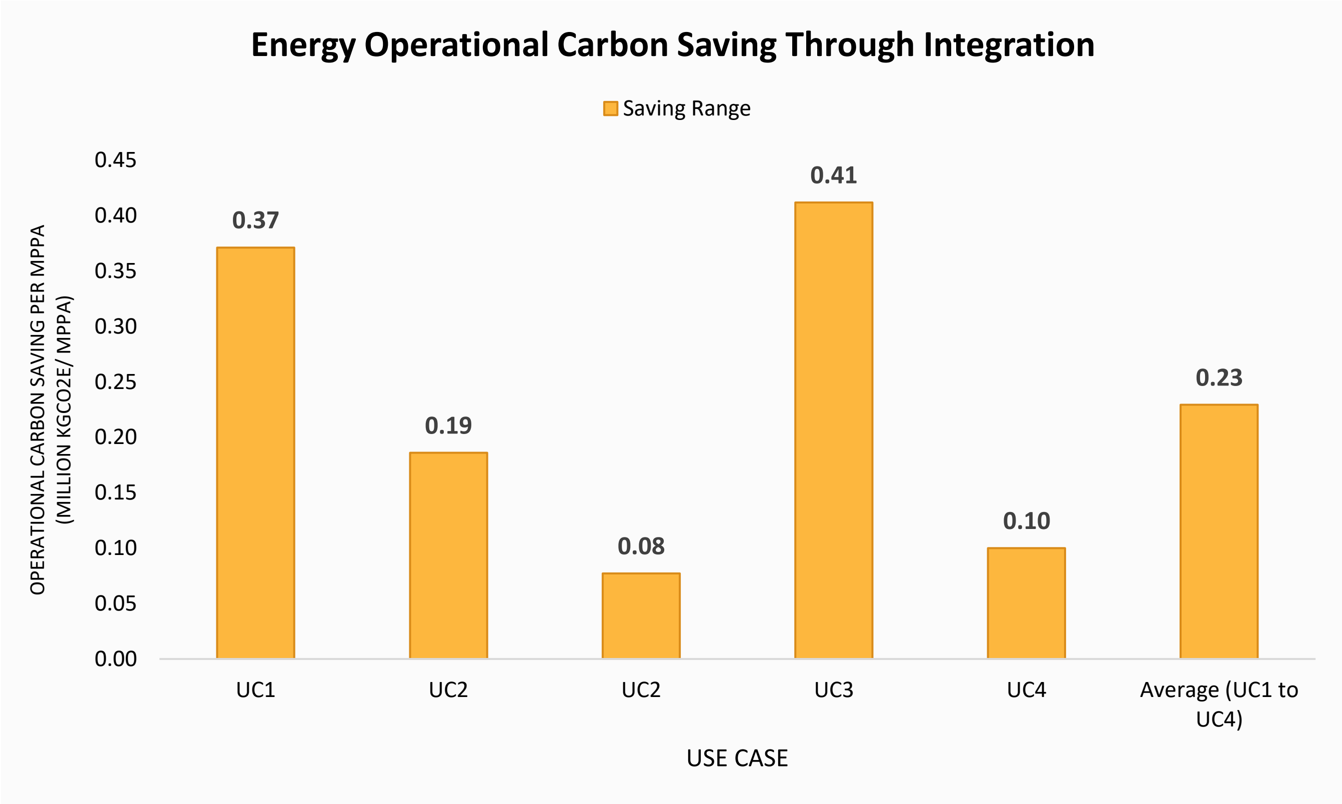


Figure 15 – Airport Operational Carbon Savings per MPPA: Energy

Generally, airports closer to being fully integrated, like UC4, have the least potential to reduce operational carbon by removing physical segregation. Several other factors, however, also play a part in determining the scale of impact. For instance, UC3 has a large terminal footprint and is in a region which requires more energy for heating, so it can therefore achieve a greater absolute saving than UC2 airports.

The graph below summarizes the observed potential annual operational carbon savings per MPPA from reduced water consumption that is achievable through integration. On average, airports can save up to 379 $kgCO_2e$/ MPPA.

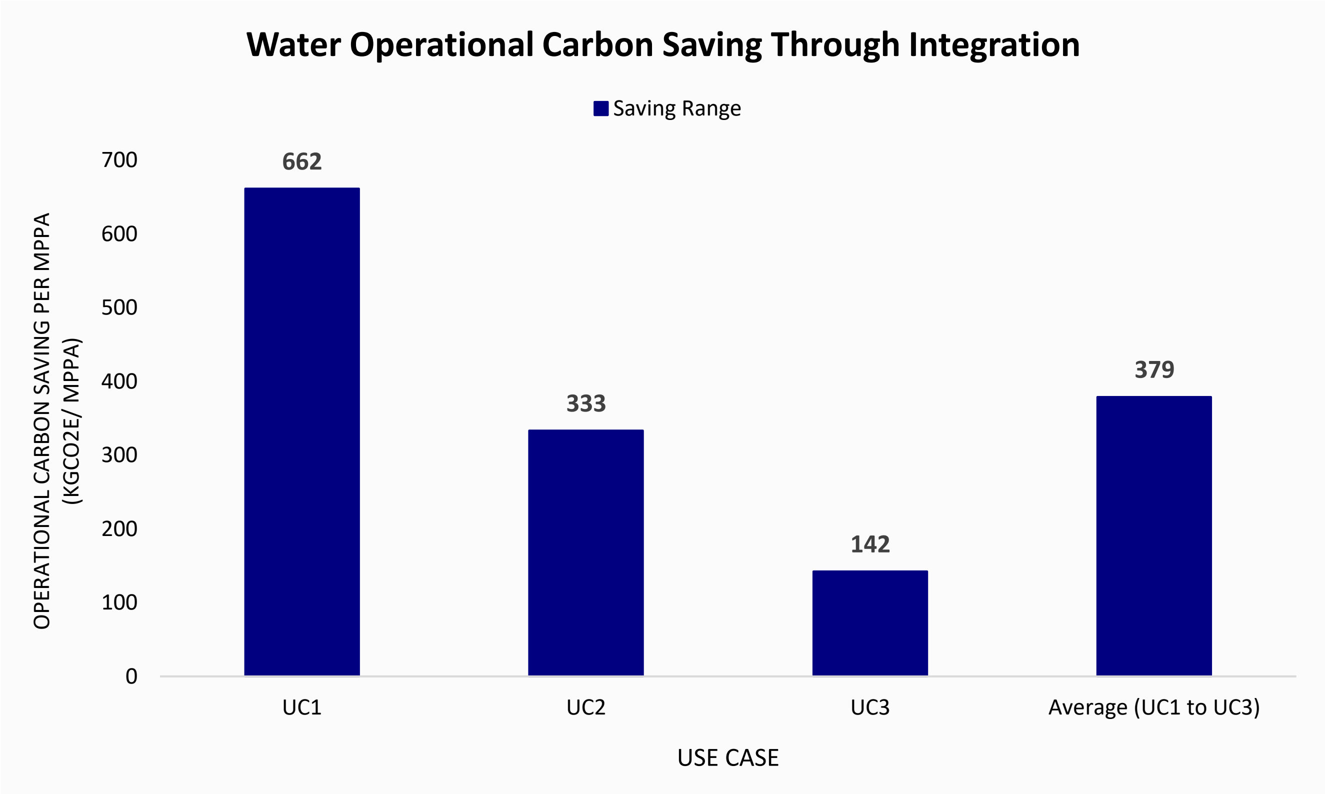


Figure 16 – Airport Operational Carbon Savings per MPPA: Water

UC1 and UC2 airports, which are the furthest from the 'end-goal' of integration, could experience the greatest benefit in water saving. It is, however, also heavily depended on the size of the F&B concessions and current scale of water use in each airport.

The figure below displays the observed potential annual operational carbon savings available to airlines from reduced aircraft fuel burn through integration. On average, airlines could save between 400,000 and 700,000 kgCO_2e per year.

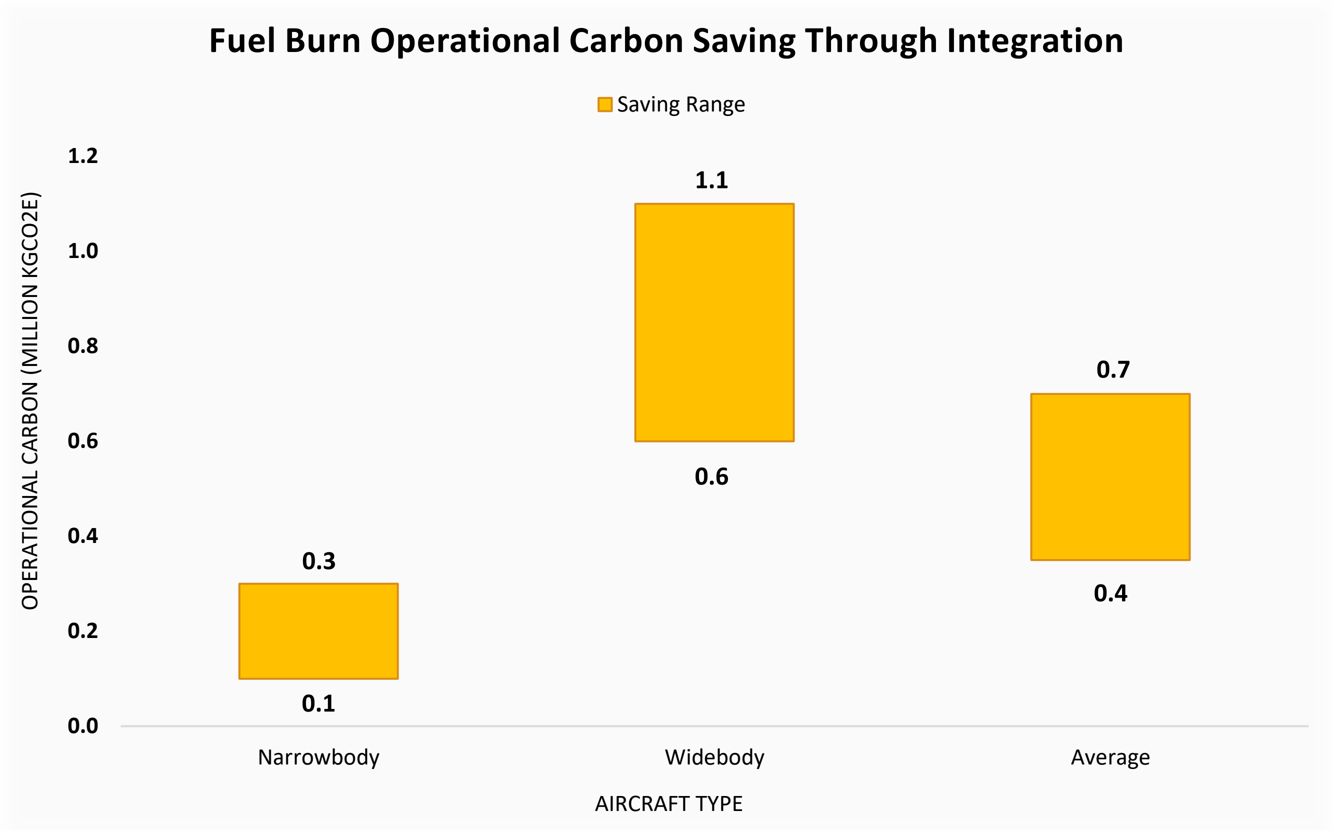


Figure 17 – Airline Operational Carbon Savings: Fuel Burn

As expected widebody aircraft could experience a greater reduction in fuel burn than narrowbody aircraft. The downstream benefit to each airline, therefore, is dependent on the type and number of aircraft in their fleet. The benefit would also be higher at airports with more ‘taxi-in’ delays caused by limited stand availability.

Sustainability Impact Summary

Passenger integration could provide the following sustainability benefits:

- Reduced embodied carbon for airports through consolidation and integration of domestic and international terminal infrastructure, allowing for future capacity enhancement without further embodied carbon implications. This benefit will be greater in airports where there is currently separation across a greater number of facilities although existing terminal sizes and CPIRs can alter this correlation.

- Reduced airport operational carbon through removal of duplicate utility consumptions (e.g., electricity, gas, water) from integration of domestic and international terminal operations. This benefit will be greater in airports where there is currently separation across a greater number of facilities.

- Reduced airline operational carbon from fuel burn through reduced ‘taxi-in’ delays, due to the greater flexibility in stand use that integration allows. This impact will be greater at airports that currently experience a higher proportion of ‘taxi-in’ delays caused by the segregation of domestic and international stands.

Reputation or Experience Impacts

Reputations and experiences may be profoundly impacted by the removal of physical segregation between domestic and international passengers in airport terminals. The following section describes the potential effects on airport and airline reputations, as well as the possible improvements in passenger experience.

Explaining the Reputation or Experience Impact

Passenger experience could be significantly enhanced by the removal of segregation. The opportunities of lower MCTs for transfer passengers have already been described in revenue terms; how space savings can reduce capital and operating costs, the chance to improve airline and airport operational and, resultantly, commercial performance. These improvements also stand to benefit passengers. Their total journey time on connecting routes could be reduced by shorter MCTs and they stand to experience reduced travel distances and journey times through airport terminals, greater retail and amenity offerings, and reduced waiting times due to improvements in OTP of aircraft. These improvements mean passenger satisfaction is projected to increase. Biometrics also has the potential to increase passenger satisfaction with quicker technology enabled processing times improving compared to traditional manual touchpoints. It is likely that passengers will find integrated airports and airlines more attractive resulting from a more seamless journey through terminals.

Passenger experience of airports, however, could be negatively affected should new biometric technology malfunction or cause delays. There is a risk that new solutions could cause reputational damage if not suitably implemented and if adequate provision is not made for resilience. Airports, for instance, will need to ensure the exceptions process is robust, otherwise passengers unwilling and unable to use the technology could have an unpleasant experience at these touchpoints. There may even be a greater number of exceptions to start with, due to initial concerns around privacy, so ensuring a viable and efficient exceptions process is critical. Busier terminal spaces and potential confusion with regards to wayfinding are also factors to consider, particularly in the early days of the new solutions.

The figure below displays the distribution of reputation or experience impacts across use cases and stakeholder groups:

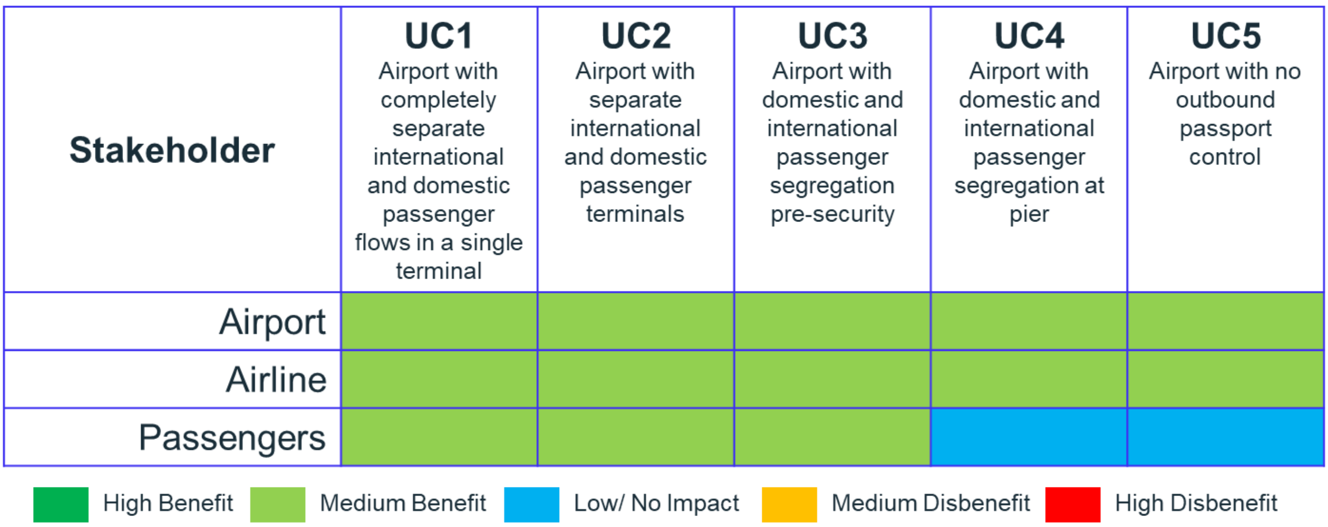


Figure 18 –Estimated Impact on Reputation/ Experience for each Stakeholder

Assessed Reputation or Experience Impacts

In the absence of quantifiable data to measure the impact across each use case, stakeholders provided statements agreeing that integration could improve passenger experience:

- Potential for quicker processing of passengers at the gate as a result of biometric technologies.
- Domestic passenger access to a greater variety of retail options.
- Increased contact stand usage, reducing passenger waiting time and improved OTP.

- Intra-terminal connections favored over inter-terminal connections.
- Reduction in towing operations, resulting in fewer delays on taxiways and convenience for passengers.

Airline representatives interviewed also identified a link between MCTs and improved passenger experience. They described how MCTs were very inconsistent before integration, varying by terminal, and too many connections were unsuccessful due to the inflexibility of the infrastructure causing delays. Since domestic and Schengen passenger integration, however, roughly 90% of their traffic has been managed from two piers in the same terminal because they have been able to optimize gate utilization based on traffic peaks. Integration now means there is a single, consistent MCT of 45 minutes, resulting in many fewer connections missed. Thus, passenger experience has been improved without the need for significant capital investment.

Reputation or Experience Impact Summary

Passenger integration could have the following impacts on reputation and experience:

- Passenger experience, and, therefore, airport and airline reputations, will improve through reduced connection times, opportunities for greater flight connections, and a more seamless passenger journey through terminal buildings.

Impacts Summary

Table 5 provides a summary of the potential impacts covered in this section by stakeholder group, comparing pre and post integration.

Table 5 – Case for Change by Stakeholder

Stakeholder Group	Segregated DOM and INT Passengers	Integrated DOM and INT Passengers
Airports	▪ Limited capacity and headroom for growth in existing infrastructure. ▪ Costs and sustainability factors associated with operating and maintaining dual facilities. ▪ Limited revenue opportunities due to capacity and segregated retail options.	▪ CAPEX savings from additional capacity and headroom for growth in existing infrastructure (e.g., terminals and aircraft stands). ▪ Reduced operational expenses (e.g., utilities, staffing) to manage integrated operations. ▪ Reduced embodied and operational carbon output (e.g., utilities) from consolidating facilities and operations. ▪ Extra revenue available from higher passenger flows, reduced MCTs and integrated retail offerings.
Airlines	▪ Limited capacity of current aircraft fleet. ▪ Necessary operational expenses (e.g., bussing and towing, staffing, fuel-burn) to manage passenger segregation. ▪ Delays caused by segregation restrict sustainability outcomes.	▪ CAPEX savings from consolidating fleet operations and creating extra capacity within existing aircraft fleet. ▪ Reduced operational expenses (e.g., bussing and towing, staffing, fuel burn) to manage integrated passengers. ▪ Reduced operational carbon from fewer 'taxi-in' delays and lower fuel burn. ▪ Extra revenue available from higher passenger flows, improved OTP and integrated retail offerings.
Ground Handlers	▪ Limited capacity of current GSE fleet. ▪ High operational expenses (e.g., staff) to manage passenger segregation. ▪ Additional revenue from handling movements for segregated passengers.	▪ CAPEX savings from optimizing bussing and towing and creating extra capacity within existing GSE fleet. ▪ Reduced operational expenses (e.g., bussing and towing, staffing) to manage integrated passengers. ▪ Reduced revenue from handling fewer bussing and towing movements for integrated passengers.
Passengers	▪ Different terminal journeys depending on destination. ▪ Longer overall terminal journey times, especially for connecting passengers.	▪ Singular streamlined journey through terminal buildings. ▪ Potential for shorter connection times. ▪ Additional efficiency and security benefits from digitized processes.

Case Studies

The details and observations made using data provided by stakeholders on the potential impacts of the DIPIP have been added to Appendix B - Case Studies. Airports, airlines and ground handlers were consulted across the different use cases, as outlined in the Assessment Approach section of this booklet.

Stakeholders are advised to read the case studies relevant to their context.

Case Study Summary

Table 6 provides an overview of the main potential impacts across the use cases. The figures presented are based on the assessments conducted. Drawing direct comparisons between case studies is not recommended because of the differing geographies and contexts of each example.

Table 6 – Use Case Assessment Summary

Impact	UC1	UC2	UC3	UC4
CAPEX	Up to \$8.01 million/ MPPA saving	Up to \$7.41 million/ MPPA saving	Up to \$7.68 million/ MPPA saving	Up to \$2.66 million/ MPPA saving
OPEX	Potential \$5.5 million annual saving	Potential \$3.5 million annual saving	Potential \$0.7 million annual saving	Potential \$5.6 million annual saving
Revenue	Potential reduction in MCTs (average 19% reduction), improvement in OTP and higher passenger flows, resulting in increased revenue.			
Sustainability	Up to 1.81 million $kgCO_2e$/ MPPA saving in embodied carbon Up to 0.37 million $kgCO_2e$/ MPPA saving in operational carbon	Up to 0.91 million $kgCO_2e$/ MPPA saving in embodied carbon Up to 0.19 million $kgCO_2e$/ MPPA saving in operational carbon	Up to 1.49 million $kgCO_2e$/ MPPA saving in embodied carbon Up to 0.41 million $kgCO_2e$/ MPPA saving in operational carbon	Up to 0.36 million $kgCO_2e$/ MPPA saving in embodied carbon Up to 0.1 million $kgCO_2e$/ MPPA saving in operational carbon
Reputation/ Experience	Lower connection times, greater flight connections, and a more seamless passenger journey improve passenger experience. Airport and airline reputations benefit as a result.			

Solutions and Implementation

The purpose of this section is to explore biometric solutions that can facilitate seamless co-location of international and domestic passenger operations. The solutions considered are applicable to all use cases and are dependent on each specific stakeholders' requirements.

The solutions vary in complexity and technological maturity, from relatively straightforward 'bolt-ons' to existing systems, to cutting-edge, forward-looking designs. Specific operational scenarios, budget availability, regulatory environments, and passenger experience goals of stakeholders will influence each airport's assessment of the most suitable integration strategy in their context.

- **Level 1 – Baseline Implementation:** This baseline-level concept includes widespread biometric capabilities within an airport system to logically segment and manage international and domestic passengers within shared terminal spaces.

- **Level 2 – Integrated Implementation:** A mature, higher complexity solution that integrates stakeholders' systems to reduce duplication of processes for co-located domestic and international passenger flows.

- **Level 3 – End State Implementation:** This concept explores the implementation of emergent technologies, including identity management and decentralized biometric verification to future-proof combined operations.

Each solution is illustrated through passenger flow diagrams and accompanied by a description of its features.

Key Assumptions

The assumptions and choices that influence how biometrics could be applied are outlined below. Some of these assumptions will not apply to every environment, due to the nature of the existing operation, regulatory blockers, local cultural norms or budget constraints.

Extent of Implemented Solution

The more complex iterations of biometric tools could offer wider benefits upon which to build an investment case, but they are also likely to require greater investment and if the integration of domestic and international flows is the sole objective, are not required or potentially more complex than they need to be.

Depending on the starting point and operational constraints of an airport, shared departure lounges could be viable with a relatively simple biometric solution, whereas other airports who want to integrate their flows may need to plan to invest in more complex technologies not yet deployed elsewhere at scale.

This guidance therefore describes three levels of solution: the minimum viable solution, an interim more mature solution and an end-state most mature solution which leverages technology concepts which have been proven but not yet deployed at scale.

Where is the border?

Authorities and airlines have raised concerns regarding the location of the border in future flows and their opportunity to intervene into self-service digital processes. Digital solutions, such as advanced passenger information, electronic visas, the proliferation of biometric border databases in support of manual border checks mean that 'the border' is already increasingly a virtual process, which begins long before the passenger travels and concludes at some point on the airport site. Biometric solutions, especially the more mature concepts, described in this report combined with these other digital solutions extend the time window and capability of authorities to receive passenger data and detect bad actors. This should provide improved capacity to intervene when compared to today's processes, which can place significant responsibility on agents as single points of failure at borders.

Focus on Departures

The focus of the assessment has been on the departures process. Biometrics implementation within the arrivals process could remove the physical segregation of domestic and international passengers. However, given the current technological maturity, this may require several biometric touchpoints and could create lengthier processes, particularly for domestic passengers. Additionally, current border control and customs regulations do not typically allow the dematerialization of physical 'entry checks'. It may well be that as technology evolves there are further opportunities in this area.

Exceptions Process

The passenger flows presented in this guidance present for the sake of simplicity only the ‘happy path’ flow, which assumes 100% uptake of the technology and 100% success of the transaction at touchpoints. Exceptions are an inevitable and important part of implementing biometric technologies. Some passengers will be unable and others unwilling to use biometric technology; they may, in some contexts:

- have concerns around privacy
- be unable to provide consent due to their age
- not meet height requirements
- have mobility restrictions
- not be able to follow the instructions presented via user interface
- hold a travel document which cannot be machine-read.

Additionally, in busy and dynamic environments like an airport, occasionally biometric processes will fail. In these situations, passengers will need to go through manual exceptions processes performed by customer service agents of the airport, airline or border authority. Robust processes and contingencies, in addition to managing the types of exceptional cases presented above, are critical to underpin the confidence of regulators and other stakeholders in the integrity of the system.

Modalities

The modality of a biometric system describes the physical human attribute being used to assess identity. The five best-known modalities with the highest worldwide take-up are face, fingerprint, iris, voice and DNA. The first three modalities have ICAO standards for use in biometric passports.

Currently, face is the most common modality used in aviation and face-based biometrics form the basis of the One ID end-state. In addition to its utilization within modern passports, face-based biometric solutions provide a high level of inherent accuracy. They can operate at long range, which allows for quick and contactless transactions and requires relatively low levels of active participation from the passenger to capture. Given these considerations, the assumed modality within solutions to facilitate the DIPIP will be face.

Digital Travel Credentials (DTC)

ICAO has been developing standards for the digitization of the passport within the wallet of a mobile phone since 2016. DTCs could eliminate the need for physical passport checks by border authorities (and airlines) at airports dematerializing the border. Trials, pilots and policy leveraging DTC have been developed but, as of today, this is not an operational solution.

Whilst technology develops quickly, developing international accepted standards for passports takes time so it is not clear what a realistic timeframe for DTC adoption within airport processes might be. Implementation timelines for the DIPIP solutions could be significant, given the regulatory angle and the capital investment cycles at airports. Flows and solutions utilizing this future technology are presented in this guidance to demonstrate the art of the possible.

Level 1 – Baseline Implementation

The Baseline Implementation involves biometric solutions for managing both international and domestic passengers within shared terminal spaces. This concept aims to provide a consistent, biometric-enabled experience for all passengers, ensuring efficiency and security without significantly altering existing workflows.

In this baseline-level solution, all passengers are enrolled in the biometric system prior to entering the shared departure lounge, creating a unified identity verification framework that supports seamless operations. Passengers are then verified at boarding, allowing for effective segmentation and management of passenger flows. This approach ensures that the shared lounge operates as a secure and efficient space for both international and domestic travelers.

A key characteristic of this solution is its flexibility in implementation. Airports can choose between deploying self-service biometric touchpoints or retrofitting traditional agent desks with biometric capabilities, depending on their operational needs and budget. This adaptability allows for a tailored approach that can accommodate varying terminal layouts, passenger volumes, and technological readiness.

As this level of implementation is not yet integrated with passport checks for international passengers, there is a recognized trade-off in potentially adding an additional step to their journey. However, this step is mitigated by the broader benefits of a consistent biometric experience across all passenger types, which enhances efficiency, reduces manual processes, and establishes a foundation for future advancements.

Baseline Implementation Passenger Flow

The figure below presents the departure journeys of direct and transfer passengers and their interaction with airport touchpoints, highlighting where the biometric solution will be deployed and transactions that will happen at those touchpoints.

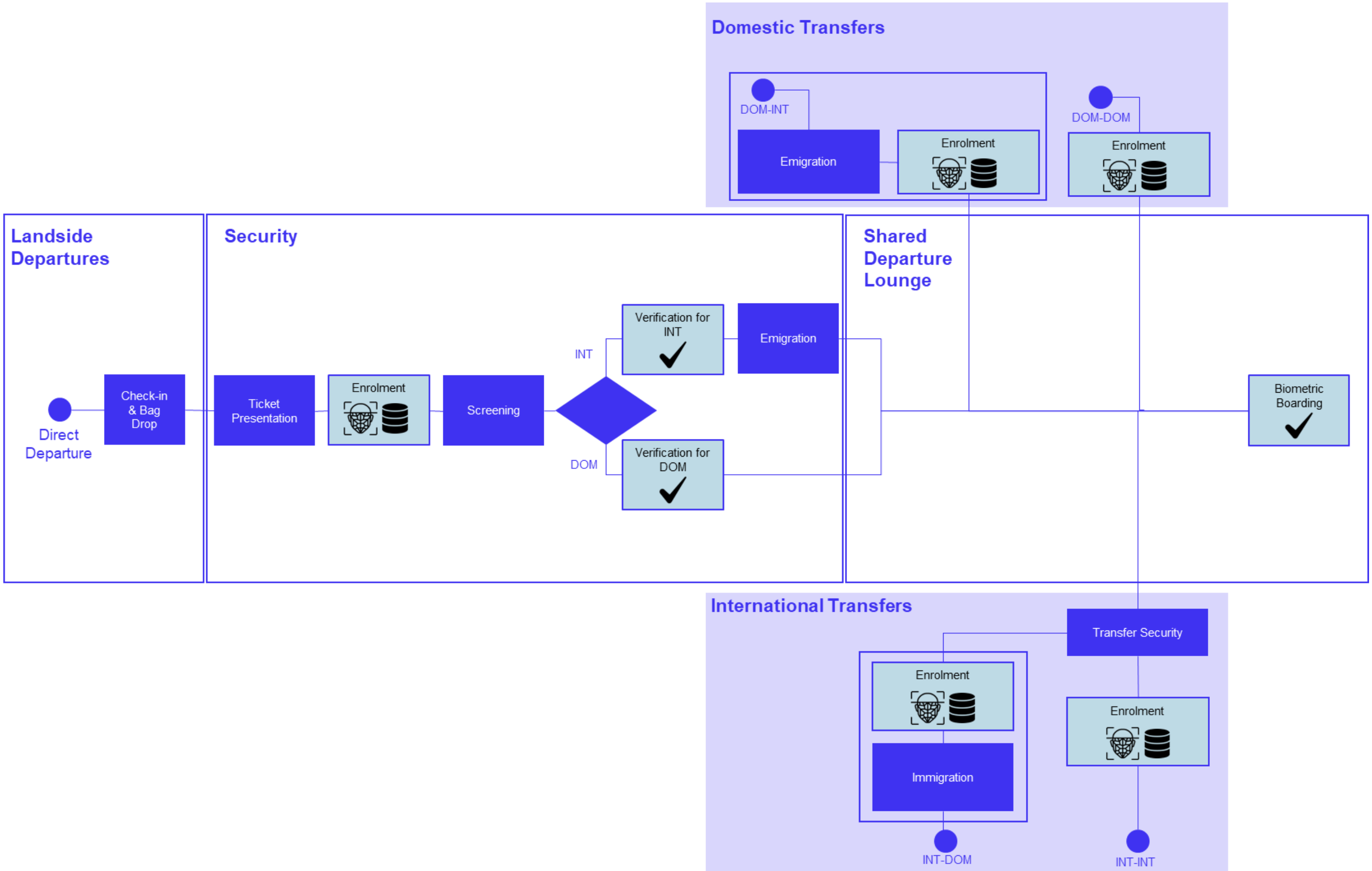


Figure 19 – Baseline Implementation Passenger Flow

Figure 20 highlights what happens within the key processes of biometric enrolment and biometric boarding.

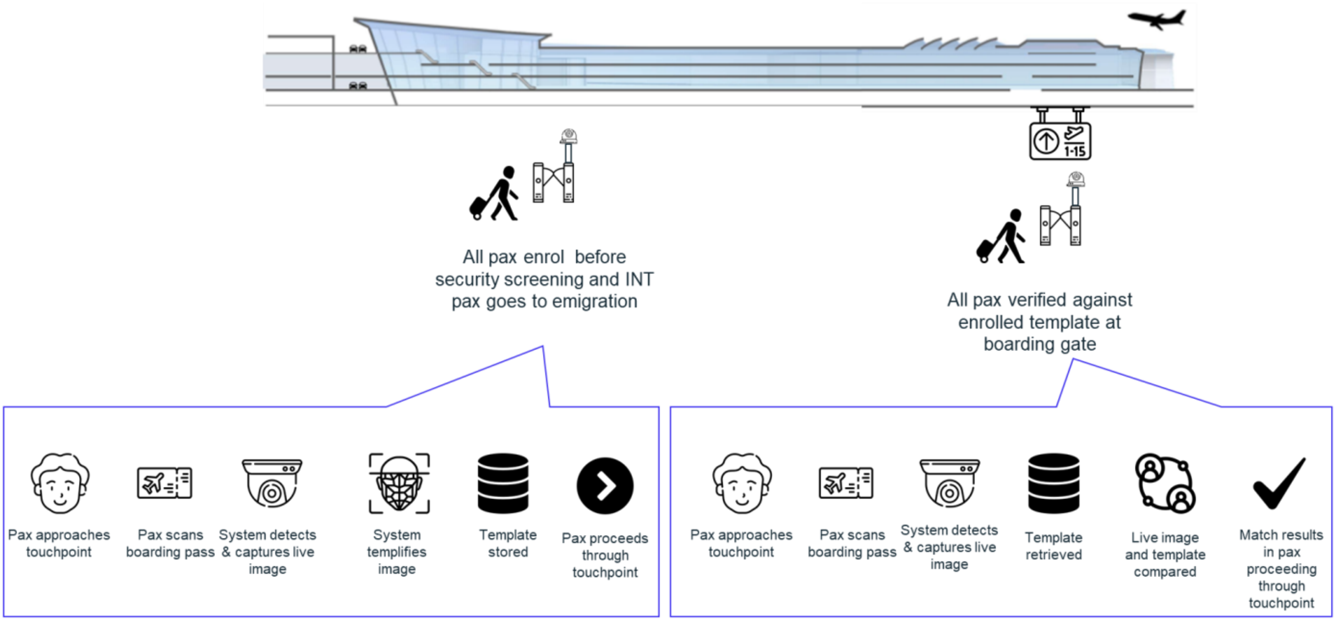


Figure 20 - Baseline Implementation Solution Concept

Level 2 – Integrated Implementation

The Integrated Implementation represents a significant advancement in biometric solutions, introducing a highly mature and complex approach to facilitating co-located domestic and international passenger flows. This solution focuses on reducing process duplication by integrating biometric systems across multiple stakeholders, including border control agencies and airlines. With close collaboration and system interoperability, this level of implementation unlocks efficiencies that go beyond what is achievable at the baseline level of maturity.

At the heart of this solution is the integration of border checks with biometric enrolment for international passengers prior to their entry into the shared departure lounge. This streamlined process consolidates enrolment with identity verification and border control requirements into a single step, enhancing the passenger experience and reducing the need for additional touchpoints. For domestic passengers, the system supports an enrolment-only process, which can either occur at shared biometric touchpoints or at dedicated domestic-only stations. Both passenger types are then verified at the boarding gate, ensuring security and compliance across all workflows.

This multi-party system facilitates real-time communication and data sharing between airport, airline and border systems, eliminating redundancies and improving operational alignment. By reducing the number of touchpoints required for enrolment, the solution not only enhances efficiency but also delivers staffing and resource optimization benefits. This approach retains flexibility in deployment, offering options for self-service biometric touchpoints or retrofitting traditional agent desks to accommodate biometric capabilities.

It should be noted that airlines and airports may choose to implement a solution in which the enrolment aspect of the biometric process takes place at check-in either on traditional desks with ancillary equipment or integrated within kiosks or self-service bag drops. Passengers would then verify against their enrolment at subsequent touch points whilst undergoing emigration if travelling internationally.

This section will detail the components and processes of the Integrated Implementation, highlighting how it reduces complexity for passengers, optimizes resource utilization and strengthens collaboration among stakeholders. Integrating border and airline processes with biometric systems sets the stage for an operationally advanced and passenger-centric terminal experience, allowing for more seamless, secure, and efficient airport operations.

Integrated Implementation Passenger Flow

The flow in the figure below shows the departure journeys of direct and transfer passengers and their interaction with airport touchpoints, highlighting where the biometric solution will be deployed and the transactions that will happen at those touchpoints.

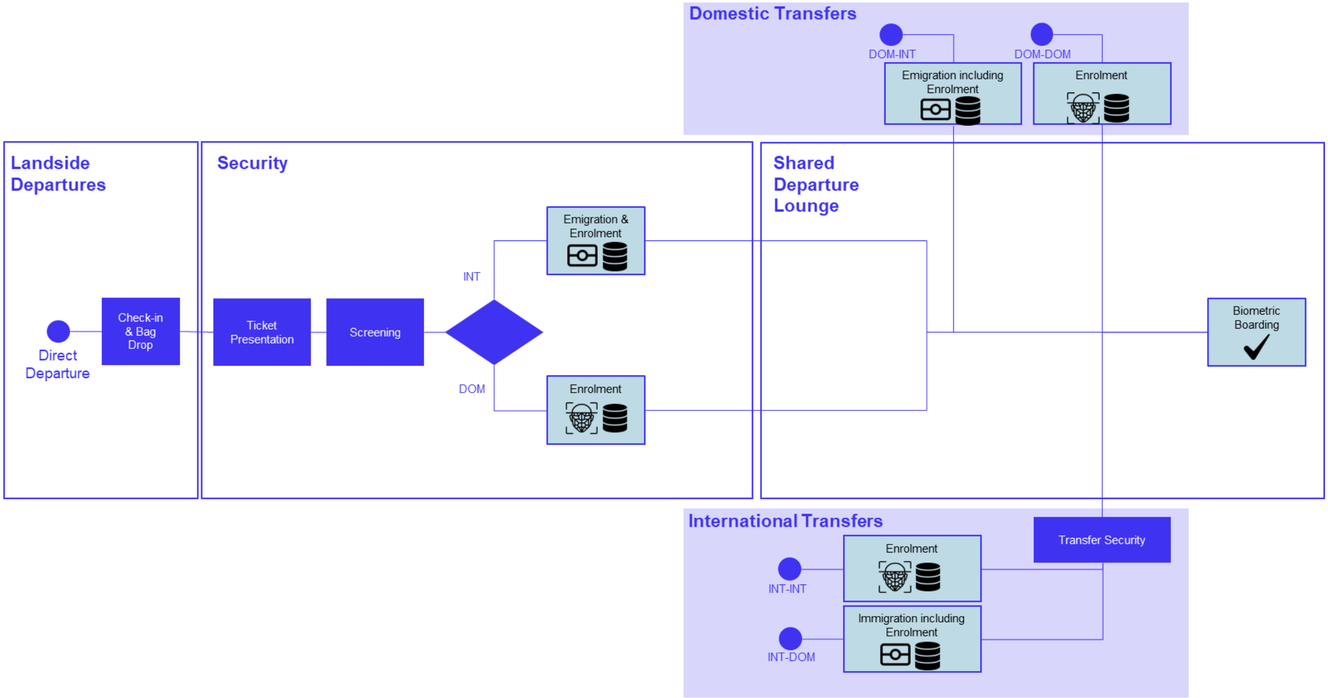


Figure 21 - Integrated Implementation Passenger Flow

In this solution, we see a new type of transaction where those crossing the border combine that process with their biometric enrolment. Passengers who do not need to engage with border processes; domestic direct departures, DOM-DOM and INT-INT transfers, will undergo a similar enrolment transaction, albeit in common areas, using the same touchpoints used by passengers undergoing border processes.

It is assumed that the integration of authority and airline systems will allow international passengers to keep their passports in their pocket or carry-on bag at boarding, with airlines receiving confirmation of the presentation of the passport at the earlier touchpoint.

Figure 22 highlights what happens within the key processes of biometric enrolment and biometric boarding.

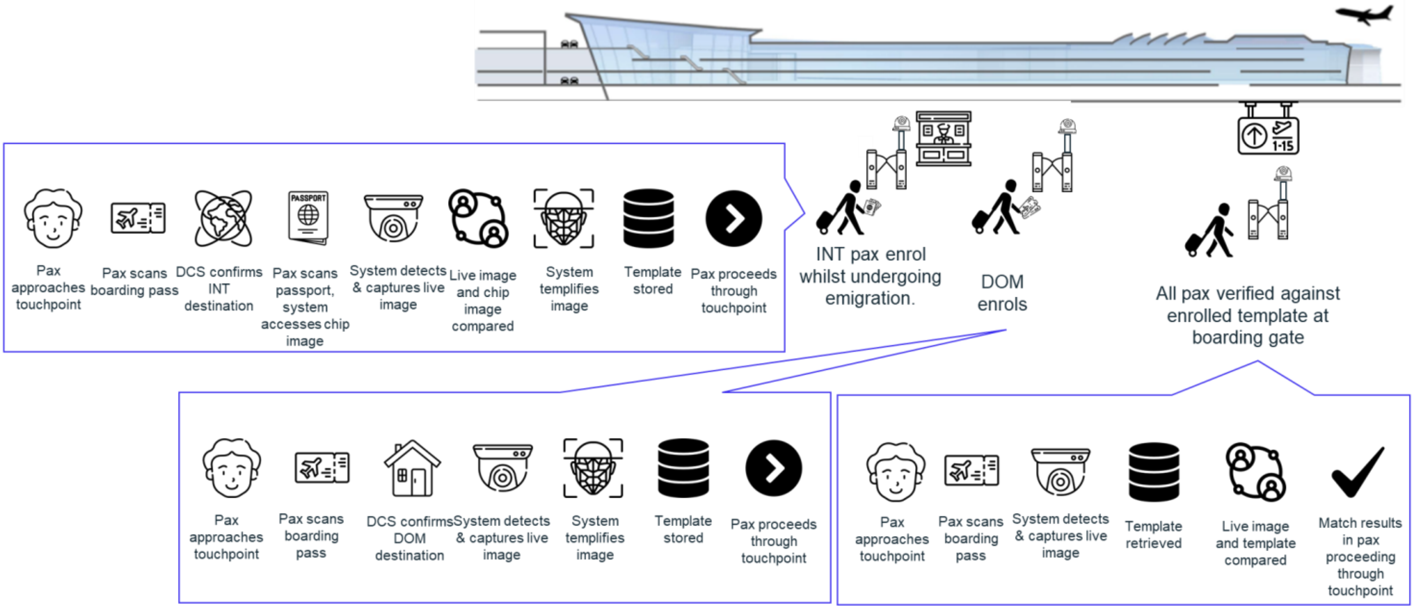


Figure 22 - Integrated Implementation Solution Concept

Level 3 – End State Implementation

The End-State Implementation represents the highest level of maturity in biometric solutions, leveraging emergent technologies to create a seamless, decentralized, and future-proof system for managing combined domestic and international passenger flows. This concept envisions a transformative shift from on-airport enrolment processes to mobile-based enrolment, where passengers can use their personal devices to complete pre-travel identity verification and, for international travelers, emigration procedures.

In this advanced scenario, mobile-enrolled passengers are verified at touchpoints, such as ticket presentation, before entering the shared departure lounge and boarding gates. This approach eliminates the need for traditional enrolment stations, reducing infrastructure demands within the terminal, while significantly enhancing passenger convenience. However, to accommodate the technological nascency and the inevitability of incomplete uptake of these solutions, the concept assumes that infrastructure for on-site enrolment and emigration processes may still be required during the transition phase.

A cornerstone of this solution is the deep integration of systems and processes across airlines, government agencies, identity management platforms, and airport operators. These stakeholders collaborate through highly interoperable and secure platforms to orchestrate passenger journeys, share data in real-time, and maintain compliance with regulatory standards. By decentralizing identity management and enabling seamless data sharing, the solution minimizes redundancies, optimizes passenger flows, and ensures a consistent, secure experience across all touchpoints.

Given that this concept is currently in its early trial stages within the industry, its full implementation will require substantial advancements in technology roll-out and commercialization, adjusted regulatory frameworks, and stakeholder coordination. This section explores the key components expected to comprise an End-State Implementation, providing a vision of how airports can leverage cutting-edge technologies to redefine the future of integrated passenger operations.

End-State Implementation Passenger Flow

Figure 23 shows a very different journey for direct and transfer passengers. They perform the enrolment and border processes remotely on their mobile device at their convenience ahead of their journey. Leveraging airline applications and dedicated solutions, which allow the digital submission of verified identity credentials to authorities, airlines and airports, passengers arrive at the airport enrolled into the airport system and, where required, approved to leave/enter the country by the border authority.

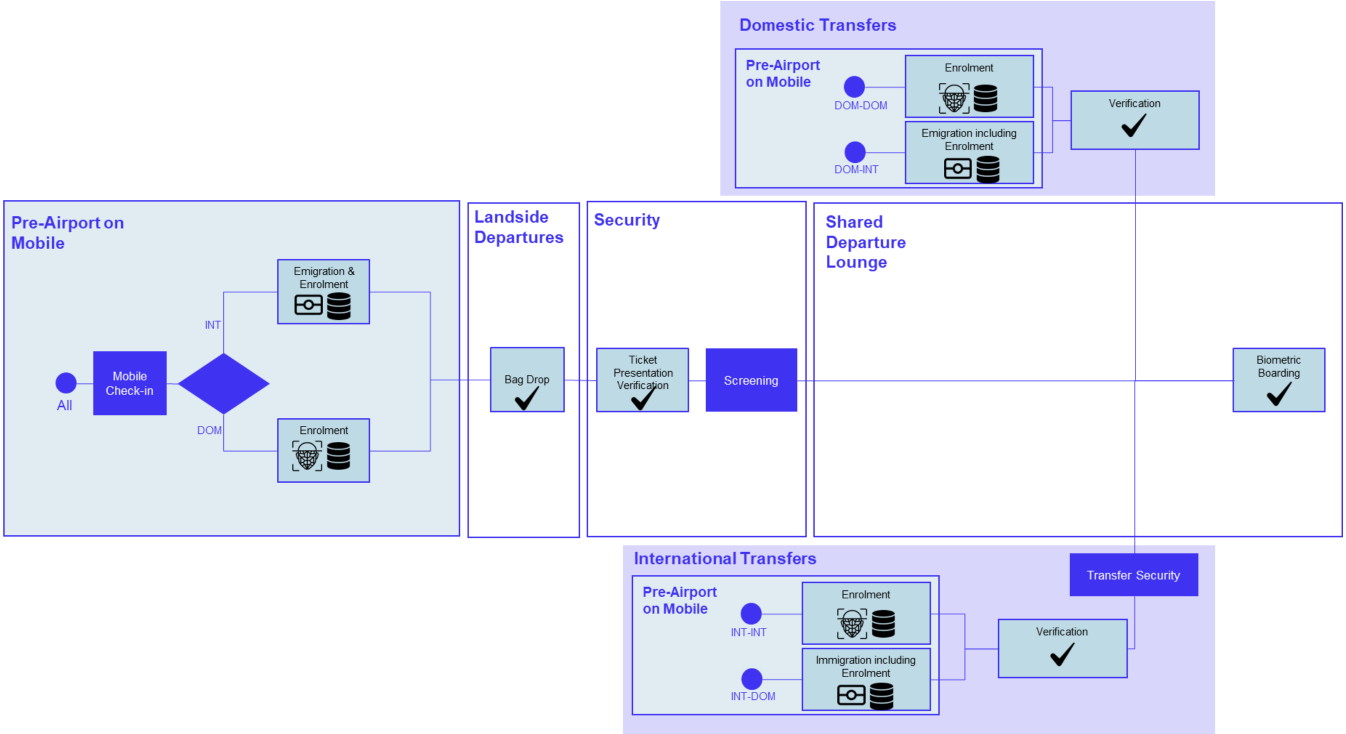


Figure 23 – End-State Implementation Passenger Flow

On airport, departing flows will mix freely, needing only to match their enrolment image to gain access to the shared airside lounge and to board their flight without needing to retrieve their physical passport.

Transfer passengers will also pre-submit their biometric enrolment and remotely go through border control. The flow retains a transfer security process for those arriving from international origins.

Figure 24 highlights what happens within the key processes of biometric enrolment and biometric boarding.

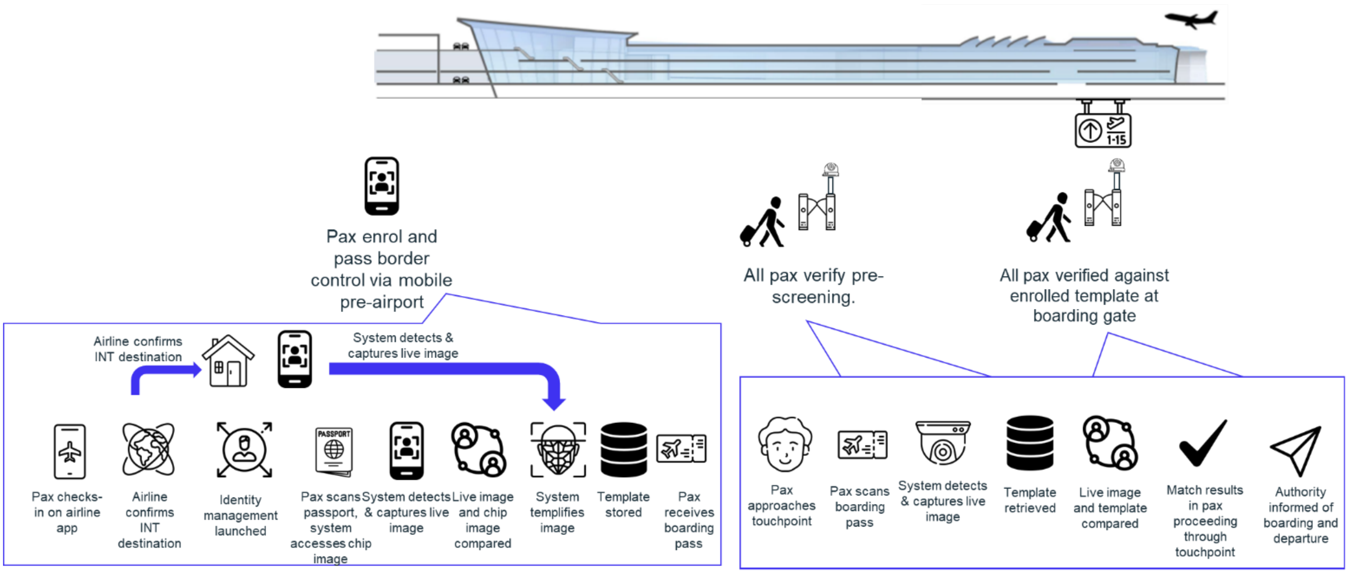


Figure 24 – End-State Implementation Solution Concept

Summary of Levels 1 to 3 Implementation

The Level 1 Baseline Implementation provides the simplest scalable solution, which would allow the mixing of domestic and international passenger flows on outbound journeys through future airports. Although limited in its capacity to deliver secondary benefits, such as improved passenger journey times or staffing efficiencies, it represents a flexible and potentially affordable solution, which could unlock the major benefits identified earlier in this booklet.

The Level 2 Integrated Implementation is a more complex but comprehensive solution, extending the benefits available to stakeholders in terms of staffing efficiency and markedly changing the convenience of the passenger experience. The viability this level of solution will depend to a much greater degree on collaboration between stakeholders, especially border authorities, than the Baseline Implementation.

The technology components necessary to enable the Level 3 End-State Implementation are already available and cross-jurisdictional trials are proceeding apace (e.g., the Hong Kong Tokyo trial under One ID). Stakeholders considering this level of solution will need to coordinate closely with their aviation and regulatory colleagues to ensure alignment and to secure the input required from authorities to allow the widespread roll-out of this transformational concept.

Impact on Use Cases

The Baseline and Integrated solutions face the following challenges:

- In UC4 where passengers today are segregated by going through passport control at the entrance to an international-only pier, in the ideal implementation of integrated operations, airports will need to spend to move the border control touchpoint far earlier in the passenger journey. However, options to maintain the current set-up and apply the integration concept to turn said piers into common areas could also be considered.

- Any installation of additional steps for domestic passengers to enroll and verify would likely be seen negatively by those passengers and their airlines. Consolidation of the enrolment touchpoint into a pre-screening ticket presentation process could mitigate that downside.

- In contexts where domestic arrivals disembark into the departure lounge, the implementation of this solution will not facilitate the continuation of that mode of operation. However, the capability to share mobile enrolments with arrival airports which currently disembark passengers directly into the departure lounge, those transferring onwards onto domestic flights could do so.

The End-State Solution will enable almost total integration of domestic and international flows through airports. Assuming an ongoing requirement to (re)screen passengers transferring who started their journey in a different jurisdiction, transfers of INT-INT and INT-DOM will need to be kept away from other flows until they are screened on arrival.

This solution will effectively eliminate the need for on-airport physical border control, meaning that there would be no need for UC4 airports currently segregating flows at international piers to re-locate passport control upstream at significant cost.

Implementation Roadmap

To successfully implement a biometric solution for integrating domestic and international passenger flows, airports, airlines and authorities should consider a structured approach to implementation. The roadmap below outlines the essential stages and associated steps required for deployment, focusing on alignment across all stakeholders, regulatory compliance and operational success.

By following this roadmap, airports, airlines and authorities can systematically design, implement, and operate biometric solutions that integrate domestic and international passenger flows while ensuring security, compliance, and operational efficiency.

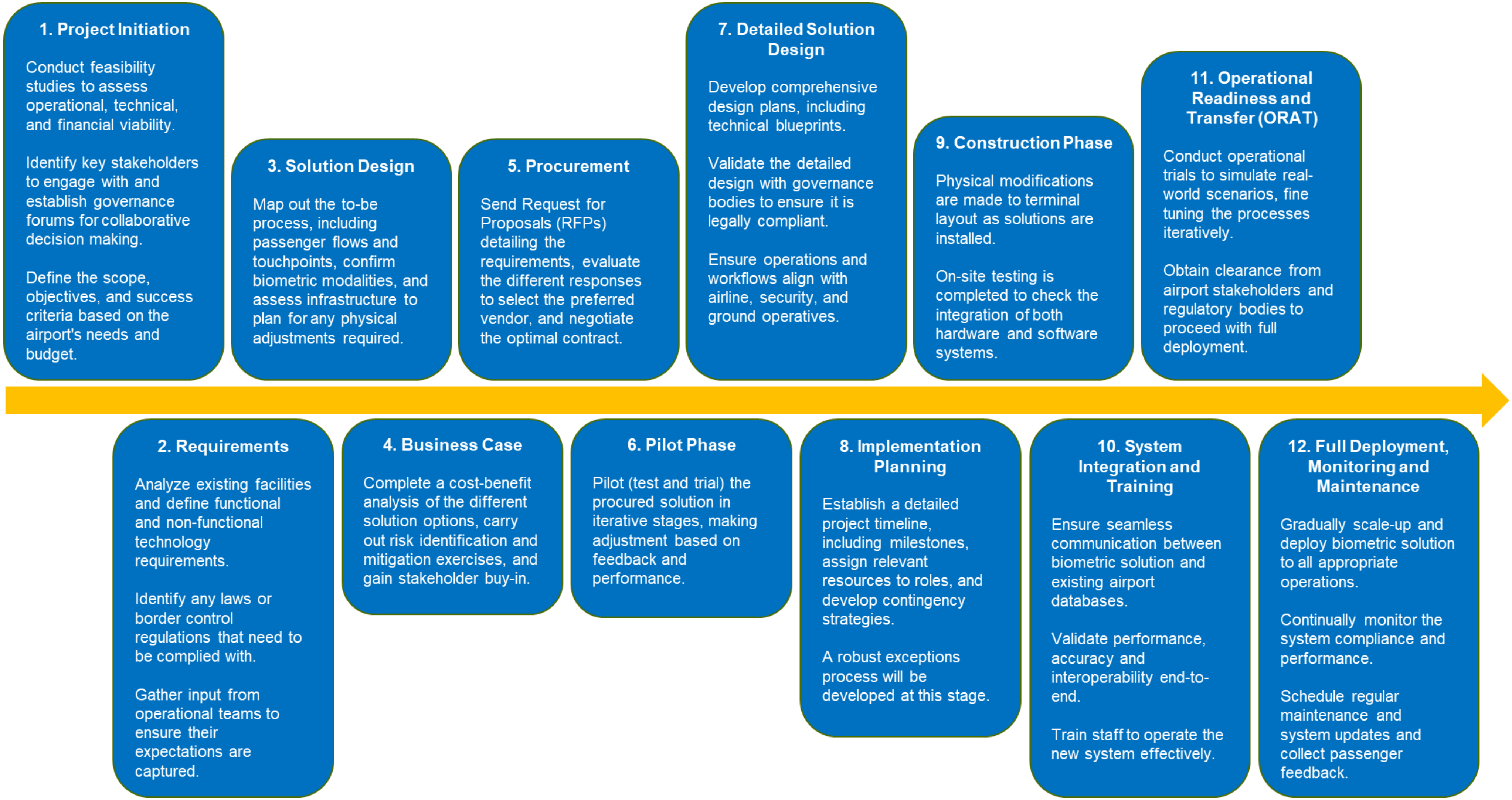


Figure 25 - Implementation Roadmap

Summary

By leveraging biometric technologies, airports can eliminate the need for physical segregation between domestic and international passengers. Airport stakeholders would create more flexible terminal spaces, enabled by secure and efficient technology, allowing for the optimization of operations and a more seamless passenger journey. IATA believes this transformation will position airports, airlines and ground handlers to better handle future growth and evolving passenger expectations.

There are many significant benefits associated with the removal of physical segregation between international and domestic passengers using biometric solutions:

- **Future CAPEX Reductions:** passenger integration reduces future CAPEX for airports, airlines and ground handlers because terminal areas can be used more efficiently and headroom for growth is unlocked.
- **Increased Revenue**: removing passenger segregation increases revenue for airlines and airports due to greater efficiencies in passenger journeys and the more flexible use of terminal space.
- **OPEX Savings:** combined passenger terminal areas offer opportunities for airports, airlines and ground handlers to save OPEX costs on staff and resources, due to the efficiency and flexibility of terminal spaces.
- **Sustainability Improvements:** combining passenger flows provides the opportunity to reduce operational carbon for airlines and airports, and reduce future embodied carbon for airports, because existing terminal infrastructure can be used more efficiently and headroom for growth is unlocked.
- **Improved Passenger Experience:** integrated terminals improve passenger experiences because they reduce connection times, can offer more services and allow for more seamless journeys. Consequently, the reputation of airports and airlines will improve.

Recommendations & Next Steps

It is recommended that all stakeholders consider the impacts in their own context before deciding whether to pursue the integration of domestic and international passengers. As evidenced in this booklet, factors such as regional context, airport size, and current levels of passenger segregation cause significant variation in the scale of impacts. The costs and benefits, therefore, should be investigated on a case-by-case basis to ensure stakeholders make informed decisions.

Further information, including business case guidance, can be received by contacting: airportdevelopment@iata.org.

Appendices

Appendix A - List of Abbreviations

Table 7 - List of Abbreviations

Abbreviation	Definition
ASQ	Airport Service Quality
ATM	Air Traffic Movement
CAPEX	Capital Expenditure
CBP	Customs and Border Protection
CPIR	Combined Passenger Impact Ratio
DIPIP	Domestic and International Passenger Integration Program
DOM	Domestic Passenger
F&B	Food and Beverage
FTE	Full Time Equivalent
GFA	Ground Floor Area
GSE	Ground Support Equipment
INT	International Passenger
MCT	Minimum Connection Time
MPPA	Million Passengers per Annum
OPEX	Operational Expenditure
OTP	On-Time Performance
PAX	Passengers
PRM	Passengers with Restricted Mobility
TVS	Traveler Verification Service
UCM	Use Case Model

Appendix B - Case Studies

Case Study (UC1) – Airport with completely separate international and domestic passenger flows in a single terminal

CAPEX Impact

A significant future CAPEX reduction of up to $374 million could be achieved through passenger integration at this large hub airport through optimizing the terminal area. This equates to $7 million/ million annual passengers.

The airport could also achieve a total future CAPEX reduction of $32.2 million through the ability to optimize stands following integration of domestic and international passengers. This equates to the removal of 7% of the stands used for passenger flight operations today.

A ground handling organization based at a UC1 airport could potentially save up to 14 busses from integration when compared to the current need to transport segregated passengers around the airport at peak periods. This equates to a potential future CAPEX reduction of up to $8.6 million.

OPEX Impact

Since there is a potential 11% headroom for growth at the airport, it could be possible to reduce airport staff costs by 11% in security and the departures lounge. The staff headcount could reduce proportionally with the reduction in combined peak hour passenger demand.

Ground handlers at the airport would be able to achieve a reduction in staff OPEX through the integration of services at check-in, baggage handling, boarding and the apron. The analysis used data provided by one ground handling organization who reported a 10% efficiency in staffing levels because of integrated operations. In this airport case study, this efficiency results in a potential cost reduction of $1.1 million for one ground handling organization.

An annual OPEX reduction of up to $4.4 million could be achieved through the reduction in annual energy consumption achieved through integration. Additionally, an annual OPEX reduction of up to $150,000 could be achieved from savings from reduced water consumption at food & beverage (F&B) outlets following integration.

Airlines at this airport could save a total of $2,400 at peak times, through optimizing the operations and reducing bussing during these periods. They would require 14 fewer bus movements in the peak 20 minutes each day. These movements were previously required to transport segregated domestic and international passengers. Additional savings would also be possible at other stages throughout the day.

Revenue Impact

In response to a questionnaire for data, the UC1 airport stated that MCTs could have a positive impact on revenue for the following reasons:

- **Increased passenger numbers:** shorter MCTs make an airport more attractive to passengers, especially those making tight connections. This could lead to an increase in passenger numbers, which in turn boosts revenue from passenger-related charges, such as terminal fees and landing fees.
- **Higher retail revenue:** with more passengers passing through the airport, there is a higher likelihood of increased spending in retail and F&B outlets. This could significantly enhance non-aeronautical revenue.
- **Enhanced passenger satisfaction:** reducing MCTs could improve the overall passenger experience, leading to higher satisfaction and potentially more repeat business. Satisfied passengers are more likely to choose the same airport for future travels.
- **Operational efficiency:** airports with efficient connection times can manage more flights and passengers without requiring significant infrastructure investments. This operational efficiency could lead to cost savings and increased profitability.

Sustainability Impact

The airport could save up to 94 million kgCO_2e of embodied carbon through the removal of passenger segregation, which is the equivalent to driving 239 million miles in an average petrol-powered passenger vehicle.

The airport could also save up to 34 million kWh annually in energy consumption through the removal of duplicate facilities and could reduce its annual water consumption by up to 86 million liters. These savings combined amount to an operational carbon saving of up to 19 million kgCO_2e, equivalent to driving 49 million miles in an average petrol-powered passenger vehicle.

Reputation or Experience Impacts

The airport stated that Airport Service Quality (ASQ) data indicates passengers generally appreciate the convenience of having facilities under one roof. Benefits such as shorter MCTs and enhanced retail options were noted positively by both international and domestic passengers. While specific ASQ data on fully integrated operations is not available, they anticipate similar improvements in overall satisfaction if segregation were to be fully lifted. Removing segregation would likely result in better connectivity and a more seamless passenger journey for domestic travelers. For those consulted, there was a positive connection between 'a smooth, efficient integration that reduces travel times and enhances passenger convenience' and 'the airport's reputation'.

Airport representatives also discussed the following as contributing to improved passenger experience:

- Potential for quicker processing of passengers at the gate as a result of biometric technologies.
- Domestic passenger access to a greater variety of retail options.
- Increased contact stand usage, reducing passenger waiting time and improved OTP.
- Intra-terminal connections favored over inter-terminal connections.
- Reduction in towing operations, resulting in fewer delays on taxiways and convenience for passengers.

Case Study (UC2a) – Airport with separate international and domestic passenger terminals

CAPEX Impact

A significant future CAPEX reduction of up to $244 million could be achieved through passenger integration at the UC2 airport. This equates to $6 million/ million annual passengers.

A future CAPEX reduction of $34.1 million could also be achieved from stand optimization. This is a saving of up to 15% of all stands used for passenger flights today and equates to approximately $1 million/ million annual passengers.

A ground handling organization based at a UC2 airport could potentially save the cost of up to 14 busses from integration when compared to the current requirement for transporting segregated passengers around the airport at peak periods. This equates to a potential future CAPEX reduction of up to $8.6 million.

Following the removal of physical segregation in terminal buildings, there is also a potential impact on aircraft utilization. Reduced towing movements required to service separate domestic and international passengers could result in shorter turnaround times for aircraft and, therefore, higher aircraft utilization. Anecdotally, higher aircraft utilization will provide airlines the opportunity to consolidate fleet operations and, in turn, increase the number of flights offered to customers. Further downstream, there is the potential for fewer aircraft needing to be procured to service airline growth.

In the absence of any data to quantify the impact of aircraft optimization, an international airline based at a UC2 airport, which runs a slot control and curfew, recognized the potential benefit. The airline commented that the later slots in the day are less attractive for international services, because peak international operations tend to happen in the morning, which leaves a large proportion of slots underutilized from an international flight perspective. In a Common Departures Lounge (CDL) there are opportunities to better utilize these slots, especially for home carriers with aircraft based at airports overnight. The flexibility of terminal space, possible through passenger integration, therefore, allows for a more efficient turnaround and optimization of aircraft fleet.

OPEX Impact

A future OPEX reduction in annual staff costs of 6% could be achieved at the airport, because it is estimated that total staff costs for currently segregated areas will reduce proportionally with the reduction in peak hour passenger demand.

An annual OPEX reduction of up to $3.4 million could be achieved through reduced energy consumption following integration. Additionally, a potential annual OPEX reduction of up to $50,000 could also be achieved from reduced water consumption at F&B outlets.

Airlines at this airport could save a total of $2,400 through optimizing bussing operations during peak periods. They would require 14 fewer bus movements in the peak 20 minutes each day. These movements were previously required to transport segregated domestic and international passengers. Additional savings would also be possible at other stages throughout the day.

Revenue Impact

An international airline based at a UC2 airport commented that there would be a big advantage in terms of additional revenue from more passengers and higher overall spend in retail facilities if MCTs reduced. Lower MCTs could provide opportunity for more flight connections. This would even be a competitive advantage to some airlines, should the airports they operate at achieve passenger integration ahead of others.

Through analysis of bus transfers from an international terminal to a domestic terminal at a UC2 airport, it was estimated that integration could result in a 10-24 min reduction in MCTs, depending on whether the bus was reached on time or required a wait. This equates to approximately an 8-20% reduction in DOM-INT and INT-DOM transfers times.

Sustainability Impact

The airport could reduce up to 35 million kgCO_2e in future embodied carbon. This is equivalent to driving 90 million miles in an average petrol-powered passenger vehicle.

The airport could reduce its operational carbon footprint by up to 7 million kgCO_2e by reducing its annual energy and water consumption through integration. This saving is equivalent to driving 18 million miles in an average petrol-powered passenger vehicle.

Reputation or Experience Impacts

An international airline based at a UC2 airport commented that integration could result in a more seamless transfer experience at their main hub airports. They said that customer sentiments have made clear that transfers are a big issue, particularly where separate terminals are far from each other, so integration is within their best interests.

Case Study (UC2b) – Airport with separate international and domestic passenger terminals

CAPEX Impact

At the other UC2 example airport, a total future CAPEX saving of $45.5 million could be achieved through optimizing terminal areas from integration. This equates to a cost reduction of $2 million/ MPPA for the areas assessed. The figure is lower than the first example because data was not available to calculate the benefit in some of the terminal facilities.

A potential future CAPEX reduction of $4.5 million, or $200,000/ million annual passengers, is also possible in the security concourse from the reduction in security lane equipment.

A future CAPEX reduction of $34.4 million is possible through stand optimization. This equates to approximately $1.5 million per MPPA by using up to 25% fewer stands for passenger aircraft than used today.

A ground handling organization based at this UC2 airport could potentially save up to 10 busses from integration when compared to the current requirement for transporting segregated passengers around the airport at peak periods. This equates to a potential future CAPEX reduction of up to $6.2 million.

Since this airport is the national base for three airlines, all of which undertake both domestic and international services, a considerable amount of towing also occurs to facilitate their operations. The airport assessed this to be approximately 10% of the ATMs at the airport and a decrease in this proportion would be expected from integration. However, in absence of a flight schedule with towing details, the potential monetary savings from towing optimization are unable to be provided.

Revenue Impact

DOM-INT and INT-DOM connections at this UC2 airport currently require a 10-minute walk between terminals. The airport estimated that integration of domestic and international flows within the terminal could remove this, resulting in a 9-13% reduction in MCTs (depending on DOM-INT or INT-DOM). They agreed that lower MCTs can offer more attractive connection opportunities, hence increasing potential airline revenue. Furthermore, if passengers are having a pleasant airport experience and a smooth journey, they are likely to spend more.

OPEX Impact

A future OPEX reduction in staff costs of 34% could be achievable at this UC2 airport, which would apply to segregated areas resourced by the airport, such as security and departures lounges areas.

The UC2 airport could also achieve a sizeable annual OPEX reduction of $0.9 million in energy.

Airlines at this airport could save $100 at peak times by reducing up to 10 bus movements in that period. The figure is lower than in other examples because of the reduced costs in the region. Whilst it may not look like a significant figure, it demonstrates the opportunities available in optimizing operations at locations where passenger integration brings a greater level of flexibility. Savings would also be possible at other stages throughout the day, and these would be more notable when considered at scale.

Ground handlers at the airport could also save on staff required for towing. Approximately 10% fewer ATMs would require towing following the integration of domestic and international passenger operations.

Sustainability Impact

The airport, although considerably smaller in size in comparison to the above UC2 airport, could realize a reduction in embodied carbon of up to 14 million $kgCO_2e$.

The airport could save 2 million $kgCO_2e$ of energy consumption annually through passenger integration. These savings are equivalent to driving 5 million miles in an average petrol-powered passenger vehicle. The water utility saving for this airport was not assessed due to the lack of accurate data on departure lounge and retail GFAs.

Case Study (UC3) – Airport with domestic and international passenger segregation pre-security

CAPEX Impact

A total future cost reduction of $173 million could be achieved by the airport, equating to $6.5 million/ million annual passengers. A further potential CAPEX saving of $6.5 million, or $0.2 million/ million annual passengers could be achieved from a resultant reduction in security lane equipment.

A CAPEX reduction of $19.2 million is achievable from optimizing stand use through integration. This equates to approximately $500,000/ million annual passengers and a saving of about 9% in passenger stands it uses today.

A ground handling organization based at a UC3 airport could potentially save up to 11 busses from integration when compared to the current requirement for transporting segregated passengers around the airport at peak periods. This equates to a potential future CAPEX reduction of up to $6.8 million.

OPEX Impact

The UC3 airport could achieve future OPEX reductions in staff costs of 23%, which would apply to terminal areas currently resourced to serve segregated passengers.

The airport could also benefit from reduced energy costs. Despite passenger segregation only happening at security, an annual cost reduction of $0.7 million could be achieved. Additionally, an annual OPEX reduction of $20,000 could be achieved through reduced water usage.

Airlines at this airport could also save on up to 11 bussing movements during the peak 20-minute period, saving a total of $2,200 at peak times. These movements were previously required to transport segregated domestic and international passengers. Optimizing operations to reduce bussing would also be possible at other times of the day.

Sustainability Impact

The airport could save up to 40 million kgCO_2e in embodied carbon, which is equivalent to driving 101 million miles in an average petrol-powered passenger vehicle.

The airport could reduce operational carbon emissions by 11 million kgCO_2e, the equivalent to driving 28 million miles in a petrol-powered passenger vehicle. This figure comprises 11 million kgCO_2e energy savings and 3,800 kgCO_2e water savings.

Case Study (UC4): Airport with domestic and international passenger segregation at pier

CAPEX Impact

A total future cost saving of $15.1 million is possible in piers and gates. Whilst not as high as other airports, this is still $2 million/ million annual passengers.

A potential future CAPEX reduction of approximately $1.7 million could be achieved through optimizing the use of stands, post-integration. This is equivalent to one stand fewer than needed today with segregated passengers at the piers.

According to an airline that operated from another UC4 airport, around 9% of the passenger stands used whilst operating with segregation were saved through passenger integration. This enabled the airline to increase its aircraft fleet size by 19% at the airport, which boosted their revenue in a declining domestic market. They stated how after the pandemic they were initially forced to adjust operations and use smaller aircraft on the main part of the domestic network. The integration of the domestic and Schengen terminal operation, however, helped to sustain a large domestic operation and, eventually, allowed for an expansion in domestic aircraft fleet. They said that without the terminal integration this expansion would not be possible as the domestic product would be too weak to take on the now higher passenger volumes.

A ground handling organization based at this UC4 airport could potentially save up to 3 busses from integration when compared to the current requirement for transporting segregated passengers around the airport at peak periods. This equates to a potential future CAPEX reduction of up to $1.8 million.

An airline working at a similar UC4 airport also suggested that reduced bussing and towing operations are a likely impact of removing segregation. When comparing the difference in movements before and after domestic and Schengen passenger integration, the 4,175 annual tows and 778 weekly bus journeys between segregated areas became redundant as Schengen passengers were allowed to mix. Whilst it is important to note the significant difference integration made, a degree of bussing and towing was still required to cater for some separate international arriving passengers.

OPEX Impact

It is unlikely that UC4 airports will witness a reduction in OPEX cost for staff because security and departures lounges are already combined and staff at piers and gates are typically provided by other organizations (e.g., airlines). Ground handlers, however, would be able to achieve a reduction in staff OPEX through the integration of services at boarding and the apron. At this UC4 airport, this results in a potential OPEX reduction of $5.3 million for one ground handling organization.

Two ground handlers operating at a different UC4 airport stated that, whilst boarding staff would still be needed, there are potential efficiencies with integration. Staff who currently need to move between Schengen and non-Schengen departure lounges can undergo lengthy checks, but with integration the same processes may be removed and the change in location may be quicker.

Although the airport would only be able to reduce energy costs at the gates and piers, an annual cost reduction of $0.3 million is achievable.

OPEX cost reductions through decreased water usage have not been calculated at this airport because domestic and international passengers are already integrated in the departures lounge and the water usage from F&B at gates and piers at this specific airport, where segregation currently occurs, is minimal.

Airlines at this specific airport could save a total of $300 on OPEX costs for bussing during the peak 20-minute period, since 3 fewer bus movements would be needed during that time. These movements were previously required to transport segregated domestic and international passengers. OPEX savings would be possible at other times of the day and would scale to sizable amounts.

However, airlines operating at a different UC4 airport could save up to $5.3 million on annual OPEX costs for bussing and towing. An airline experienced a reduction of almost 89% in weekly bussing operations to remote stands once the integration of domestic and Schengen passengers was implemented, primarily through opportunities to reduce journeys to remote stands. Similarly, 4,175 annual towing operations were also reduced, after being found redundant in the year following passenger integration.

Anecdotally, one stakeholder suggested that segregation causes 10-20 minutes of delays, resulting from aircraft waiting for a specific stand to become available on taxi-in. Assuming this and cost of the fuel burnt per minute, an airline that is based at a UC4 airport could save between $55 and $412 per 'taxi-in' delay. The airline could reduce OPEX associated with fuel burn, due to 'taxi-in' delays, from the greater stand flexibility integration allows. Due to the variability in the number of 'taxi-in' delays each week, it has not been possible to scale up these figures.

Revenue Impact

In an interview with stakeholders from this UC4 airport, they described how lower MCTs leads to better opportunities to connect and improved passenger experience. This contributes to the attractiveness of the airport and, in turn, increased profitability.

An airline based at a different UC4 airport stated that the number of potential connections possible within the airline network increased by 15% following integration. Hence, with a greater flight offering, they achieved higher revenue figures. Although DOM-DOM MCTs increased by 40%, the benefit was achieved due to a 22% reduction in DOM-Schengen MCTs and a 25% reduction in DOM-non-Schengen MCTs.

Sustainability Impact

This airport could reduce embodied carbon by up to 2.5 million $kgCO_2e$. A lower saving range is expected because its current operation is only segregated at the piers. Despite this, the savings are still notable as they are equivalent to driving 6.5 million miles in an average petrol-powered passenger vehicle.

The airport could reduce operational carbon by 700,000 $kgCO_2e$ annually. This is equivalent to driving 2 million miles in an average petrol-powered passenger vehicle. Given this airport only segregates international passengers at the pier, it was deemed there would be minimal impact, if any, on water consumption.

On average, an airline operating from a UC4 airport could reduce operational carbon associated with fuel burn by up to 2,400 $kgCO_2e$ per 'taxi-in' delay that is removed from integration. It is important to note the savings depend on the aircraft type and current scale of delays caused by the problems associated with passenger segregation.

Reputation or Experience Impacts

In an interview with an airline based in a UC4 airport, they explained how, at one airport they regularly operate at, MCTs significantly improved through passenger integration and that it was hugely beneficial for passengers. They described how MCTs were very inconsistent before integration, varying by terminal, and too many connections were unsuccessful due to the inflexibility of the infrastructure causing delays. Since domestic and Schengen passenger integration, however, roughly 90% of their traffic has been managed from two piers in the same terminal because they have been able to optimize gate utilization based on traffic peaks. Gates in domestic areas were underutilized and, when used, resulted in longer travel distances for domestic passengers. Integration now means there is a single, consistent MCT of 45 minutes, resulting in many fewer connections missed. This was further enabled by the practice of allocating flights with high transfer rates on stands near to each other. Thus, passenger experience has been improved without the need for significant capital investment.

The airline did also highlight the risk of some domestic passengers feeling that domestic product was becoming worse because of no longer having dedicated security processes. In some interviews, stakeholders even said to expect concern or confusion about being treated differently as a domestic or international passenger when mixing with Schengen flights.

In a different interview with a UC4 airport, it was also confirmed that if lower MCTs were possible through passenger integration, it would lead to better opportunities to connect passengers and would improve the passenger experience. A greater offering of possible flight connections would likely increase the attractiveness of the airport. They also stated that an integrated terminal would be especially attractive to passengers with restricted mobility (PRM) if there were to be a reduction in bussing and an increase contact stand usage.

Additionally, biometric trials for departing passengers had recently been tested at the airport and had received very good feedback from passengers overall. Passengers said they were happy to see efforts to speed up terminal processes.

Appendix C - Critical Concepts and Risks

The following concepts and assumptions are those that stakeholders interested in adopting passenger integration need to be aware of. The list covers the most important items, as agreed by industry experts, and touches on a range of factors. Solution specific concepts are called out in the Solutions section.

Regulation and Logical Segregation

Many governments require the physical segregation of international and domestic (or equivalent, for example intra-Schengen journeys) passengers at airports. EU law, for example, currently requires the physical segregation of international and domestic traffic.

According to Regulation (EC) No. 300/2008, *"The competent authorities of the Member States shall ensure that the airport operator takes the requisite measures to physically separate the flows of passengers on internal flights from the flows of passengers on other flights. Appropriate infrastructures shall be set in place at all international airports to that end".*

A fundamental assumption underpinning DIPIP is that this physical segregation can by replaced by *logical* segregation, where the biometric solution allows domestic passengers to be distinguished from international passengers. If a requirement for physical segregation is fixed, biometric solutions cannot enable integration. The scope of DIPIP will be significantly limited geographically if there is not widespread acceptance of this principle and the necessary changes to regulation. Early and on-going engagement with authorities forms a crucial aspect of any implementation efforts.

Geopolitical and global security concerns mean that authorities will likely need to be convinced of the superiority of technology solutions, and robustness of contingency measures, in detecting fraudulent actors compared to traditional regimes underpinned by human agents and physical separation of passenger groups.

Differentiated Security Screening

In many countries there is a national standard level of screening meaning domestic to international (DOM-INT) or domestic to domestic (DOM-DOM) passengers do not need to be re-screened prior to their onward leg. Elsewhere, lower levels of screening on domestic journeys mean that transferring passengers would need to go through screening again before their international departure on a DOM-INT journey.

DIPIP is incompatible with differentiated screening. If lower levels of checks were applied to domestic passengers who then mix with international passengers in a shared lounge, heightened international screening would be compromised.

This guidance has been developed on the assumption that screening for international and domestic travel will be of the same level. Therefore, the flows will show that passengers transferring from a domestic origin will not need to be re-screened, but passengers transferring from an international origin are assumed to be subject to re-screening. Whilst some countries do recognize the level of security of other countries sufficient to avoid re-screening of INT-DOM/INT passengers, the solutions proposed for DIPIP do not consider that an additional pre-requisite.

Transfer Journeys

There is significant variety in processes transferring passengers are subjected to on their journeys through airports in different jurisdictions.

International to International Transfers

In some locations international to international (INT-INT) transfer journeys do not have to pass through the border of their transfer station. In others, they must and may even need a visa for their very short period in the transfer point. Border processes, including visa validation, for INT-INT journeys could be facilitated in integrated facilities and, in the future, enabled by biometric and identity management solutions. To simplify this guidance, flows are presented where INT-INT journeys do not require border crossing.

Risks and Opportunities

The risks and opportunities presented in the table below vary in the level of likelihood and potential impact, as well as how easy they are for stakeholders to manage.

Table 8 – Risks and Opportunities

Title	Risk	Opportunity	How to mitigate the risk or enhance the opportunity
Future Regulatory Change	There is a risk that laws and regulations to do with the mixing of international and domestic passengers, or using biometrics, change. This could result in solutions becoming unfeasible. Similarly, there is a risk of diversity in regulation between different regions that could limit the feasibility of the more mature solutions.	There is an opportunity to support aviation authorities in shaping and forming regulations on passenger mixing and biometrics. This would help biometric technologies to be adopted more easily. Indeed, in some cases, initial regulatory change will be required to implement solutions.	▪ Provide evidence to governments to increase confidence in the efficacy of utilizing new biometrics. ▪ Develop a contingency playbook for dealing with regulatory change.
Confidence in Biometric Technology	There is a risk that the public, both passengers and authorities, could lose confidence or trust in biometric technology. This could result in solutions becoming impractical and lead to reputational damage for airport stakeholders.	Biometrics also offer a significant opportunity to increase public confidence in passenger processes at airport terminals. It could enhance airport stakeholder reputations. Implementation of biometrics is an opportunity to follow 'secure by design' principles, which could enhance the adoption of biometrics by the public.	▪ Increase education and awareness. ▪ Test and trial each solution before implementation. ▪ Plan robust exceptions and resilience measures.
Airport Operations	There is a risk that removal of segregation makes it harder to manage other airport operations (e.g., duty free customs). This could result in operational inefficiencies in different passenger processes.	There is an opportunity for innovating airport services (e.g., retail offerings) for combined demographics. This could enhance existing operations.	▪ Develop logical workarounds e.g. showing boarding cards at duty free. ▪ Review the impact on airport operations in the local context.
Passenger Journeys	During transition, there is a risk of disrupting passengers' journeys because of confusion in wayfinding or unfamiliarity with biometric checkpoints. This could lead to reputational damage for airport stakeholders.	There is an opportunity for biometric solutions to improve the efficiency of passenger journeys and ease wayfinding, which could enhance passenger experience and increase the attractiveness of airports.	▪ Ensure wayfinding is clear throughout the passenger journey. ▪ Develop a robust exceptions process for passengers who do not want to, or are unable to, use biometrics.

	For domestic travelers, there is a risk that the arrivals process becomes less efficient, which may have similar consequences.	Likewise, there is an opportunity to strengthen the idea of airport terminals as destinations in their own right, through better retail offerings and experiences. This could also enhance passenger satisfaction.	▪ Think carefully about how to use the complete flexibility of integration within the local context.
Security	There is a risk of more alternative security concerns arising in combined passenger areas. This could lead to reputation damage of airports and airlines.	Biometric solutions provide an opportunity to increase security and safety, because they are secure by design. This could enhance the reputation of airports and airlines.	▪ Effective solutions are dependent upon maintaining robust, reliable, and scalable security services. ▪ Adherence to robust cyber-security principles.
International Relations	There is a risk that inter-government relationships disrupt the viability of more mature integration solutions. This could risk the viability of some solutions.	Mature solutions are an opportunity for increased collaboration and cooperation between regions. This could increase the viability of some solutions.	▪ Ensure robust international agreements are in place. ▪ Build upon best practices elsewhere and lean into strong existing international relationships.
Privacy Legislation	There is a risk that more mature solutions may infringe privacy legislation, due to increased data sharing. Control of sensitive passenger details may become more difficult.	In jurisdictions where there are stricter privacy legislations, there is an opportunity for biometric implementation to be more carefully designed and implemented than in other regions. This could increase the security associated with sensitive data. When managed correctly, there is also an opportunity to capture more data and increase insights on passenger demographics. This could enhance solutions offered and generate efficiencies for airports and airlines.	▪ Ensure privacy regulations are at the center of design and implementation.