AtkinsRéalis

# Concept of Operations: Passenger Data

Innovate UK

May 2024

# FUTURE OF FLIGHT CHALLENGE PHASE 3

# Notice

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This document has 64 pages including the cover.

## Document history

Document title: Concept of Operations: Passenger Data

| Document reference: Revision | Purpose description | Originated | Checked | Reviewed | Authorised | Date |
|---|---|---|---|---|---|---|
| 0.1 | Draft for review | KG | | | | 26/05/2023 |
| 0.2 | Revised draft for review (updated with revised passenger journey) | KG | | GS | | 30/10/2023 |
| 0.3 | Revised draft for review (updated with weight data processing information) | KG | | GS | | 12/01/2024 |
| 0.4 | Final draft for review | KG | | GS | | 25/01/2024 |
| 1.0 | Release to AMEC | KG | | | GS | 26/01/2024 |
| 1.1 | Accessibility revision for review | KG | | RE | RE | 03/05/2024 |

## Client signoff

| | |
|---|---|
| **Client** | Innovate UK |
| **Project** | FUTURE OF FLIGHT CHALLENGE PHASE 3 |
| **Job number** | 5216308 |
| **Client signature/date** | |

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# Glossary

| Term | Description |
|---|---|
| Advanced Air Mobility (AAM) | A safe air transportation system for passengers and cargo over relatively short distances in urban and rural locations. |
| Biometrics | Inherent physical characteristics unique to an individual, used to help distinguish that individual from others. |
| Electric vertical take-off and landing (eVTOL) aircraft | A type of piloted or unpiloted aircraft that uses electric power to hover, take-off and land vertically, without the need for a runway. |
| Exception | A specific situation within the vertiport such that an individual passenger cannot immediately proceed smoothly on their journey. |
| Data category | A collection or group of data items with common characteristics. |
| Data destination | The person or organisation that is the end user of a category of data. |
| Data origin | The person or organisation from which a category of data originates. |
| Data protection | Legal requirement to safeguard information from corruption, compromise, or loss. |
| Data protection impact assessment (DPIA) | A mechanism for methodically assessing and documenting potential data protection risks. |
| Data security | Protective measures that prevent to unauthorised access and improper use of personal digital information. |
| General Data Protection Regulation (GDPR) | A legal framework that sets guidelines for the collection and processing of personal information. |
| Identity as a service (IDaaS) | A cloud-based solution for identity and access management functions used by individuals to prove their own identity. |
| Identity management | 1. The check that the person named on the ticket is the person travelling, usually through an image associated with an account or an identity document produced by an operator.<br>2. Linkage of a person's inherent identity to wider information potentially including travel and identity documents. |
| Manifest | A list of passengers and crew of an eVTOL aircraft that contains basic information about passengers. |
| Stakeholder | An organisation or person involved in the vertiport passenger journey. |
| System | An information or communications system involved in the vertiport passenger journey. |
| Passenger journey | The sequence of processes experienced by a passenger from researching travel options through to arriving at the destination. |
| Vertiport | Facilities designed to process passengers using eVTOL aircraft. Located in rural, urban or airport environments. |

# EXECUTIVE SUMMARY

# Executive summary

Advanced Air Mobility (AAM) is a concept for a safe air transportation system for passengers and cargo in urban and rural locations. It is the next disruption in aviation, and looks to provide safe air transportation of people and cargo on routes currently under-served by aviation using innovative, carbon emission free technologies.

One of the primary benefits of AAM in comparison to ground-based modes of transport is the significant reduction in passenger travel time. As such, it is vital that, in comparison to traditional air travel, the effort and time taken to access a ticket, travel through a vertiport, board an electric vertical take-off and landing (eVTOL) aircraft, and disembark, is minimised whilst maintaining the necessary standard of security requirements. Should passengers spend a considerable amount of their total journey time on the ground, the benefits of this novel mode of transport may not be realised.

The need to process passengers quickly and efficiently can be achieved by implementing a seamless passenger journey: one that is non-intrusive, enables paperless or ticketless travel, and has minimal or no duplication of any passenger processes. To manage demand, it is expected that, at least in the early days, a passenger will book their flight before arriving at, and travelling through, a vertiport without disruption or delay.

Biometric and identity management technology can improve the speed and accuracy of passenger identity checks whilst contributing to an improved passenger experience and a reduction in operational costs that, in turn, will make eVTOL transport more affordable. However, the right level of identity management must be achieved to avoid overburdening passengers.

To achieve these benefits, the flow of data between systems and stakeholders throughout the passenger journey needs to be well-defined and understood by those involved. Flight operators and vertiport operators will share passenger data relating to a specific eVTOL flight at various touchpoints throughout the passenger journey to non-intrusively conduct all required pre-departure checks. Once passengers have completed the eVTOL flight, vertiport operators will delete the data associated with that single eVTOL journey, with flight operators retaining data only for as long as needed to fulfil any regulatory responsibilities.

As processors of personal data, flight operators, vertiport operators and potentially other third-party data handlers will need to understand, and adhere to, data protection regulations. Prior to solution design and implementation, a lawful basis for processing personal data needs to be established, a data protection impact assessment undertaken, and data security controls and measures agreed.

Aspirations for a seamless passenger journey hinge on the correct definition of data exchanges and collaboration between stakeholders involved. Without clear definition and understanding of passenger journey data flows, silos could form between systems and stakeholders. This would cause disruptions and delays to passengers as they travel through a vertiport.

In the short term, operations will be small scale and passenger numbers will be low, but ambitions for passenger eVTOL transport to become highly accessible and affordable to the public are expected to see demand soar. Passenger journey solutions should be designed with this vision at the forefront to make the transition from small to large scale operations as seamless as possible.

# 1. Introduction

The AAM market is estimated to be worth $2 billion by 2030[1]. It is set to transform the transportation landscape, reducing congestion and carbon emissions, by providing a Green, sustainable service. This evolving, innovative mode of transport is still very much in its infancy but ambitions for widespread adoption in the not-too-distant future accelerate the need to consider the challenges this evolving industry will need to overcome if it wishes to realise this vision.

Passenger eVTOL services will provide the public with an alternative, accessible and affordable mode of transport that significantly reduces journey times when compared with existing transport services such as travel by car or train. This, in turn, places greater emphasis on streamlining the journey through the vertiport. Should passengers be required to spend considerably more time in the vertiport than travelling to their destination, the attractiveness of eVTOL services would be diminished.

This Concept of Operations aims to provide an overview of the passenger journey, and the role biometric and identity management technology can play in achieving a seamless passenger experience. It will describe how data underpins this journey, identifying the type of data exchanges and stakeholders involved. It introduces the data protection implications and will look ahead to assess the impact of future AAM use cases.

## 1.1 The need for a seamless passenger journey

The sequence of processes that passengers experience, from booking an eVTOL flight to reaching the end destination, make up the passenger journey. If AAM is to provide a viable alternative to other forms of ground transportation, and encourage a change in travel behaviour, the entire end-to-end journey needs to be quick, efficient, and hassle-free.

The processes involved in the passenger journey could theoretically be conducted manually. This would require manned ticket desks and call centres, and vertiport staff to be located throughout the journey to assist, direct and process passengers, like the approach adopted by airports before the relatively recent push towards automation[2].

Automation of passenger journey processes enables a seamless, hassle-free travel experience through increased efficiency and the removal of the need for passengers to continuously present documentation at various points throughout their journey. It also



[1] Levitate Capital: the Future of the Drone Economy (Ref A1.1)

[2] How Heathrow uses innovation and automation as a creative leap to a more sustainable future (Ref A1.2)

reduces operational costs, as fewer employees are required to process passengers; these savings can be passed on to the passengers themselves to help make eVTOL transport more affordable. These benefits have already been proven in larger scale commercial aviation.

In the long term, it is feasible to think that technological advancements could enable an automated passenger journey that can be managed remotely with minimal human interaction. This vision is still some way off, with several challenges to overcome first, but industry ambitions to provide an affordable, secure mode of transport mean it should be the ultimate passenger processing objective.

Initially, a hybrid approach is likely to be taken, as it is more practical and should help with public acceptance. Automated passenger processing technology will be implemented in the vertiport but with passenger assistance agents on hand to assist where required. These agents will enhance customer service as the AAM passenger experience matures, and support passengers who are unable or unwilling to undergo a fully self-service experience prior to a given eVTOL flight.

## 1.2 The role of biometrics and identity management in AAM

Biometrics and Identity Management have already been successfully implemented as passenger processing solutions in existing modes of transport, to enhance the passenger experience and improve security. They are commonly found in airports, where they are used to confirm the identity of departing passengers quickly and efficiently and remove the need for the duplication of identity checks throughout the passenger journey. Whilst trained and skilled staff can perform these identity checks manually, the speed at which automated technologies can process passengers reduces time spent queueing, enhances security, and improves the travel experience. An example use case is at Heathrow Airport, which operates a common departure lounge. Biometrics are used to enable domestic passengers to share space with international passengers, but prevent domestic passengers from boarding international flights.

While existing aviation processes are the natural starting point in the development of the eVTOL passenger journey, we should consider the processes applied in a domestic aviation context, as well as within ground-based forms of domestic transportation, for example rail. These are considered in the accompanying analysis in Section 3.6 The role of biometrics and identity management in domestic transport.

Like rail passengers, eVTOL passengers will create an account to purchase their ticket. This enables passengers to save their regular journeys and billing details to make buying tickets quicker and easier. Additionally, passengers will be able to associate a ‘selfie’ image with their account and tickets, to enable biometrics within the vertiport and delivery of the concept ‘my face is my ticket’.

In a potential future use case where AAM flights cross international borders, or where enhanced integration with airports exists to enable a seamless link to international travel, it should be possible for passengers to verify their identity using their passport, as

recently implemented by Eurostar[3]. Passengers should also have the option to associate a digital ID with their account, to enable the management of a single digital identification record. Digital ID is discussed in further detail in Section 3.7 Who owns and shares the identity data?

Initially, passenger numbers are expected to be relatively low, however, the increased accessibility and affordability anticipated from future services, as well as the adoption of AAM for additional use cases (such as integrated journeys as described in Section 8.1 Integrated multi-modal journeys), will see demand soar. Increased passenger numbers will place additional emphasis on the need to rapidly process passengers, as the vertiport business model does not support having large numbers of passengers in the building at any one time. The fundamental requirements that link the passenger, their booking, and their departing eVTOL flight in near-real-time will remain largely unchanged; but with additional complexities arising as AAM scales up (e.g., the transition to processing multiple eVTOL flights concurrently at a single vertiport). Passenger journey solutions should be designed with this future state in mind, to ensure a smooth transition to large-scale commercial eVTOL operations.

## 1.3 The need for passenger weight checks

All aircraft have a maximum take-off weight (permissible weight to fly safely). For large aircraft, flight operators apply an average weight to passengers and allow a baggage weight limit to reduce the likelihood that the take-off weight will be exceeded. The larger the aircraft, the larger the average weight allowance applied. However, for light aircraft and helicopters the tolerance for variance in passenger weight is reduced, to the extent that it is necessary to weigh passengers. The small size of early eVTOL aircraft puts them into this same bracket, and operators will need to calculate the exact weight of passengers and their baggage as close to take-off as possible, to ensure that the aircraft is safe to fly.

**Passenger weight is a sensitive subject, and we should not underestimate the risk to the social acceptance of AAM of getting this wrong**

While the weighing of passengers of light aircraft and helicopters is a process that already exists, for most of the population this would be a new experience and therefore the need to weigh to take an eVTOL flight is likely to come as a surprise. Passenger weight is a sensitive subject, and we should not underestimate the risk to the social acceptance of AAM, nor the reputational risk to eVTOL operators for getting this aspect of the journey wrong[4]. Passengers will need to be aware, ideally ahead of booking, that it is necessary to capture their weight data and, most importantly, understand why. Flight operators will also need to incorporate this within the terms and conditions of sale. All



[3] Eurostar Rolls Out 'SmartCheck' Facial Biometric Check-In System (Ref A2.1)

[4] Travellers shocked after airline weighs woman on baggage scale | The Independent (Ref A2.2)

passengers will want to be treated with dignity, and the process of weighing within the vertiport should be as discreet as possible.

To avoid the risk of an aircraft's maximum take-off weight being exceeded, flight operators are likely to pre-empt issues by asking passengers to provide details of their weight at the point of booking, or, for those passengers for whom the booking is being made by someone else, as a condition to the issuing of their ticket, an average weight being used as a placeholder.

## 1.4 Why is data important?

The efficient exchange of passenger personal data between stakeholders and systems involved in the passenger journey underpins a seamless experience. The stakeholders involved need to be able to access accurate passenger data when required, to prevent unnecessary disruption and delays.

Understanding the type, frequency and volume of data involved at each stage of the journey, the reason that data is involved, and the stakeholders involved in the exchange will help define solution requirements.

These requirements will also be influenced by data protection implications associated with processing personal data. The importance of considering these implications at this early stage cannot be understated. Not only will clear communication around this topic be key to public acceptance, but those involved in processing data will face significant fines and reputational damage if done so incorrectly. Any solution design activities must incorporate data protection legislation requirements and controls to prevent issues further down the road.

## 1.5 The inclusive journey

The consumer vision for 2030 set out in the UKRI Future Flight Vision Roadmap[5] describes how new classes of air vehicles will benefit consumers and sets out the societal, environmental, and economic goals. Anticipated benefits include improvements in access to services and employment opportunities for those with reduced mobility, and a predicted 1.8% increase in GDP with 628,000 jobs supported.

In data published by the Department for Work and Pensions (DWP) in October 2023[6], it was reported that nearly one in four of the working age population are classed as disabled, and therefore there is the potential for people with disabilities to represent a significant proportion of AAM service users.



[5] UKRI-130821-Future Flight Vision Roadmap.pdf (Ref A1.3)

[6] Employment of disabled people 2023 – GOV.UK (www.gov.uk) (Ref A3.1)

The Government's 2019 manifesto[7] committed to empowering and supporting disabled people. A goal to achieving this is to close the disability employment gap (the difference between the number of disabled people in work compared to the number of non-disabled people).

In 2021, the government published the National Disability Strategy[8], setting out the actions it will take to improve the everyday lives of all disabled people. The strategy notes that we all want to live "fulfilling lives", to "live an independent life", and to "participate in society, to be valued, to go to work". However, for many disabled people, their everyday experience is very different to that of non-disabled people, presenting barriers to achieving what most would consider commonplace aspirations.

Transport policy is recognised as having a part to play in improving lives, and the strategy acknowledged that while the Department for Transport's (DfT) Inclusive Transport Strategy[9] has "helped to accelerate progress", "challenges are often significant" and "there is still a lot to do".

In February 2024, Advanced Mobility Ecosystem Consortium (AMEC) members hosted a disability focus group, to explore the lived experiences of disabled people in the context of public transport, and to share thinking around the AAM passenger journey. The overriding lesson from participants was that inclusion is for everybody. They called for an attitudinal change: for inclusion to be considered as a norm, not a special accommodation. Participants felt that designing inclusive services would make travel experiences better for everybody, not just disabled people.

Participants remarked on weaknesses in the current policy environment preventing the realisation of inclusive travel, and saw an opportunity for policy-makers to embed the requirements of disabled people into this novel form of transport from the outset, "potentially revolutionising inclusive travel by setting an exemplar for all other modes of transport".

According to Scope[10], a leading disability equality charity in England and Wales, and research published by Purple, in 2020 the collective spending power of disabled people and their households was estimated to be worth £274 billion per year to UK business with a loss to transport providers of £42 million per year by not being accessible.



[7] Conservative Party Manifesto 2019 (conservatives.com) (Ref A3.3)

[8] National Disability Strategy (publishing.service.gov.uk) (Ref A3.4)

[9] The Inclusive Transport Strategy: achieving equal access for disabled people – GOV.UK (www.gov.uk) (Ref A3.5)

[10] Accessibility and disability UK statistics – Scope for business (Ref A3.2)

We call upon policy-makers and AAM operators in the public transport space to use this unique opportunity to put inclusivity at the heart of service design, and to lead the way in improving the lives of all disabled people.

Though this document does not provide comprehensive accessibility design solutions, we highlight where opportunities exist to make touchpoints accessible, and welcome suggestions from anyone with an interest in this subject.

# 2. The passenger journey

To take an eVTOL flight, passengers may undertake many of the processes found in commercial aviation, including booking, check-in, security, and boarding.

In international commercial aviation, passengers are required to check-in to provide Advanced Passenger Information (API) and access their boarding passes. However, provision of API is not a requirement in domestic transport and the process of check-in adds an unnecessary step for passengers. Like ground based domestic transport, passengers will be able to access their ticket at the point of purchase.

Other key logistical differences – such as the smaller size of a vertiport and an eVTOL aircraft, shorter journeys, and a fundamentally different business model – require adaptation and increased use of technology to implement a seamless and efficient end-to-end passenger journey. This implementation of technology will enable minimal staffing at a vertiport; while proactive communication combined with encouraging passengers to manage their identity before their arrival will reduce the amount of time spent within the vertiport. A passenger-centric approach that encompasses a passenger's needs and wants will be essential in securing public acceptance and widespread demand for eVTOL services.

This document covers all processes that the passenger will experience, from searching flight options to arrival at the destination vertiport. The journey is designed to scale and adapt over time, as technology advances and focus shifts to the incorporation of more use cases, such as integrated onward travel (including crossing international borders) and enabling on-demand eVTOL services.

The basic 'happy day' journey (i.e. one that goes according to plan without exceptions) is shown in Figure 2-1 – The passenger journey, followed by a narrative about transit through the individual touchpoints. It should be noted that each touchpoint has been defined by what it is functionally achieving. Some possible exceptions are noted in Section 2.2 Process exceptions and use of technology, and the role of technology is explored briefly.

How the journey might evolve to incorporate further use cases is depicted in Figure 2-2 – The evolving passenger journey.

## 2.1 eVTOL use cases

This report focuses on several ‘passenger as a consumer’ use cases described by UK Research and Innovation (UKRI) in its Future Flight Vision Roadmap, and considers the differences between them in terms of the passenger journey. Unless stated, it is assumed that the passenger journey for each use case will be largely the same. Variations are described where appropriate.

The UKRI use cases covered are:

### UC01 Inter-town transit

Access to convenient air travel for mobility between towns and cities. Passengers can access a scheduled electric-or-hydrogen-powered aircraft on high-density routes. The air travel element connects seamlessly with other forms of transport, to create a kerb-to-kerb mobility system that users can access with a single ticket.

### UC04 Intra-city journey

Passengers have access to autonomous eVTOL vehicles for mobility between urban locations as an additional mode of transport.

### UC09 Rural/disconnected transport

Air taxis, for transit between rural and traditionally disconnected areas on a scheduled/on-demand service as part of a highly distributed aviation system.

### UC10 Airport transport

Passengers have access to on-demand air mobility to provide transit between their homes and nearby airports, between hub airports and local airports for onward transfer between airports and high-volume cities and towns.

### UC11 Sightseeing

Tourists have access to circular journeys (take-off and landing at the same vertiport) for sightseeing purposes.

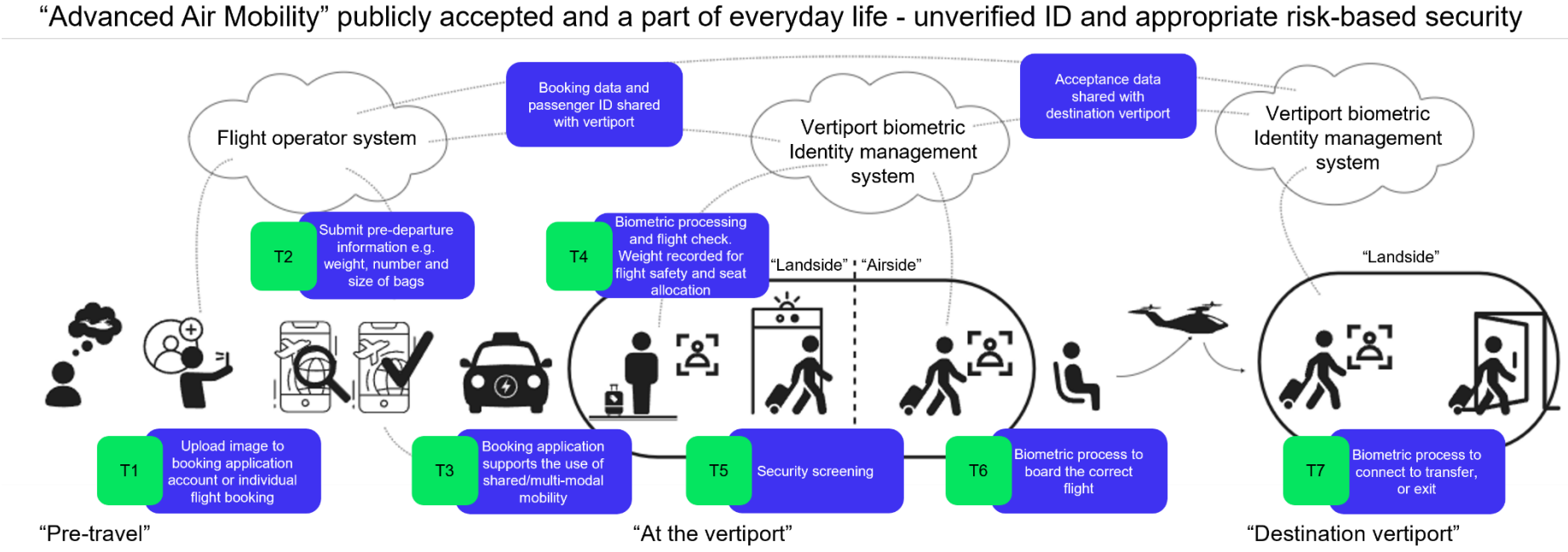


**Figure 2-1 – The passenger journey**

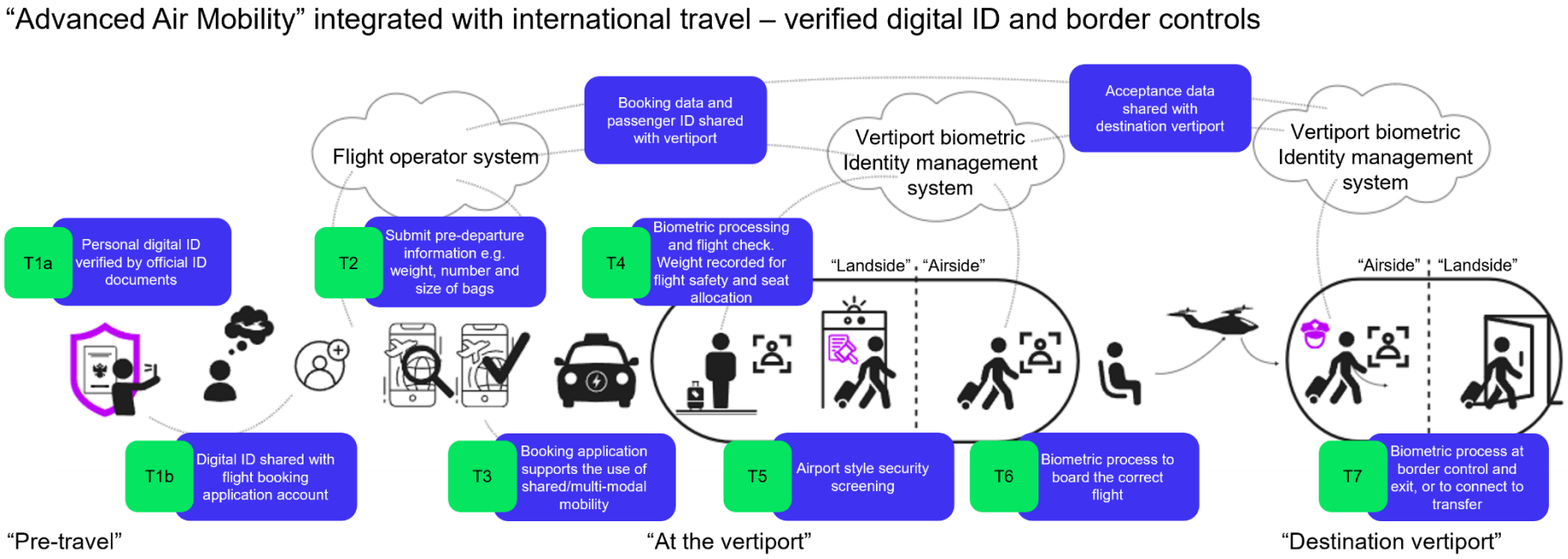


**Figure 2-2 – The evolving passenger journey**

### 2.1.1 Searching and booking an eVTOL flight (Touchpoints T1 and T2)

Given that passengers could be making short journeys at relatively short notice, the process of booking should be effortless. A passenger will likely use their preferred flight operator's mobile booking application to search for, select and book their desired eVTOL flight. The passenger should be able to book any flight with any operator through their preferred application and this is discussed in more detail in Section 4 Interoperability in the AAM industry.

Passengers will provide details of their weight, the number and size of bags, agree to share their data with operators for the purposes of the journey, and agree to the conditions of carriage which will be clearly visible and likely to include the need for passengers to confirm they will not exceed the combined passenger and baggage weight limit for eVTOL aircraft. Having made payment, the flight booking will be confirmed, with a booking reference and ticket issued.

#### 2.1.1.1 Create account

Passengers will be required to create an account and to associate a 'selfie' image with their account, which will enable the concept 'my face is my ticket'. Creating an account will also enable to them to save regular journeys, avoiding repetitive data entry for future bookings, and manage notifications throughout their journeys. They may have saved their payment details to their account, or they may wish to pay using payment data held within their mobile device wallet. Minimal information will be required: name, email address and mobile phone number, plus a passport style selfie image to aid the biometric matching process within the vertiport. The selfie taken will be associated to any booking made and will not be required each time. Passengers may create an account in advance of searching for and making their booking, or create an account as part of the booking process. Where a passenger has created their account in advance, they will log in to complete their booking.

While the concept 'my face is my ticket' will remove the need for passengers to present a ticket to gain entry to the vertiport, operators will need to consider how the process of capturing the image is accessible for disabled passengers.

In the future, to enable international travel, the passenger may be managing a verified digital ID through the application or may be sharing a digital ID held in an ID as a Service solution. This is discussed in Section 3.7 Who owns and shares the identity data?.

#### 2.1.1.2 Providing weight information

Collecting weight data early in the process would enable operators to anticipate the aircraft's payload and restrict the sale of tickets once the payload meets a defined threshold, avoiding the need to contact passengers ahead of their planned journey to reschedule their booking and be subjected to a poor experience. The fear that passengers will be told that they are too heavy to fly is real, and restricting the sale of tickets once a threshold is met significantly reduces the chance of this happening.

To achieve this, it would be necessary for flight operators to determine the aircraft that will be used before releasing tickets for sale, for passengers to provide details of their weight, or their weight within a range, at the point of booking, and for booking systems to calculate the combined weight of passengers, preventing the sale of tickets once a

defined weight threshold is met. Calculations will need to consider variances in the maximum take-off weight caused by weather conditions on the day. The difference in atmospheric pressure on a hot day versus a cold day means that the maximum take-off weight will be lower on a hot day.

If, in the future, flights operate on a regular schedule, the need to prevent the sale of tickets could be avoided. If the maximum take-off weight for one flight was exceeded but the next flight was only a few minutes away and capacity existed, passengers could be incentivised to take the next flight.

Should flight operators set out a maximum weight for a passenger, perhaps through terms and conditions, passengers exceeding the weight may be offered the opportunity to book an additional seat, where availability exists. This would require eVTOL manufacturers to consider flexibility of seat configuration so that passengers can sit comfortably.

It is anticipated that passengers will be asked to confirm the number of bags they will be taking. With limited capacity, baggage allowances are likely to be much smaller than in traditional aviation, so flight operators could offer accompanying baggage collection services such as “Airportr” for the transportation of additional or larger items. It will be difficult for a passenger to calculate the weight of their luggage, particularly if they are booking several days or weeks in advance. Based upon the bags selected by the passenger, flight operators will apply an average weight per bag to calculate the anticipated payload.

To minimise the risk of passengers travelling with baggage that is too large, the booking application could include augmented reality functionality to enable a passenger to scan their baggage and confirm the baggage is within the size restrictions ahead of travelling.

#### 2.1.1.3 Group bookings and bookings made by another party

The booking processes for all use cases will need to cater for both the individual passenger and groups of passengers. Where a group is not a family unit, the lead passenger, or the booker, where booked by someone not travelling, is unlikely to be able to provide either the weight of their fellow passengers or an image. In these scenarios, the flight operator would need to assume an average weight until the actual weight was submitted. There will need to be a mechanism for passengers to provide this information, and accept the terms of carriage, to obtain their tickets.

#### 2.1.1.4 Special assistance requests

An important aspect of the journey for passengers with reduced mobility or a non-visible disability is knowing exactly what to expect during their journey, what support exists and how to obtain that support, to have confidence that they will be able to complete their journey with dignity. For neurodiverse passengers, precise details of what they will

expect to see, hear, feel, and smell throughout their journey is important in reducing anxiety around travel and good examples of how this can be achieved exist[11].

Vertiports will need to incorporate accessibility requirements within their design to accommodate passengers with a wide range of disabilities, and booking mechanisms must enable passengers to request support with ease and give confidence that the support request has been understood.

Since 2013, a British Standard has existed for wheelchairs[12], providing information about the wheelchair including dimensions, weight, battery, and operation, and the user's personal and emergency medical information. IATA acknowledges the British Standard and has issued guidance on the transport of mobility aids[13]. If the passport was available in an electronic format, a passenger could scan the passport as part of their special assistance request, passing specific information to the flight operator.

#### 2.1.1.5 Variations between use cases

### All use cases (on demand service)

The exchange of data during the eVTOL flight booking phase will largely remain the same, except for the timings governing the exchange of passenger data between the flight operator and vertiport operator; a greater proportion of individual passenger records (rather than an expected daily manifest known in advance) will be exchanged. The flight operator will be responsible for sending individual passenger records in near-real-time, as and when they receive bookings for their on-demand services. The vertiport operator will receive passenger records just before the passenger concerned arrives at the vertiport, to ensure they can progress through passenger acceptance.

### UC10 Airport transport

In the short term, where the passenger is using an eVTOL service to connect to a flight from an airport as part of the same journey, and until demand is such to warrant the provision of self-service booking functionality, airline operators may insist upon passengers booking directly through a service centre. The eVTOL flight may be offered as a transfer in a similar way to the offering of coach transfers in a package holiday, extending this offering in advance of their flight. eVTOL 'transfer flights' might not be on a schedule but bookable in advance and on demand. Including the eVTOL flight as a leg



[11] Tour Accessibility – Warner Bros. Studio Tour London (wbstudiotour.co.uk) (Ref A2.3)

[12] Publicly available specification for wheelchair passports achieves British Standard status | BSI (bsigroup.com) (Ref A2.4)

[13] Guidance on the Transport of Mobility Aids (iata.org) (Ref A2.5)

of the journey means that passengers could be issued a single multi-leg IATA standard bar-coded boarding pass.

As is the case with airline bookings, once all legs of the journey have been confirmed, the passenger will be required to check-in to their flights, usually this is from around 72 hours before flights are due to depart. When checking in, the passenger will need to prove their identity and agree to the conditions of carriage.

### UC11 Sightseeing

It is likely that a larger proportion of passengers taking sightseeing flights will be visitors from overseas, the booking more likely to be a one-off and therefore made directly through a website or through a tour operator. They are unlikely to create an account for what might be a one-off purchase and, unless mandated for security reasons, there may be no reason for sightseeing passengers to share their ID. In this scenario, the passenger might need to scan their ticket rather than using biometrics at passenger acceptance. The design of booking websites should be user-centric, ensuring language is not a barrier to passengers understanding and accepting terms and conditions of sale.

## 2.1.2 Travel and entry to the vertiport (Touchpoint T3)

On the day of departure, the passenger will travel to the vertiport. Before they commence their journey, they could receive notification of the flight status. They could arrange travel themselves or choose to book a vehicle as part of an integrated service offered by the vertiport or flight operator included in their ticket (see also Section 8.1 Integrated multi-modal journeys).

Where parking is available at the vertiport, passengers should be able to prebook their space and Automatic Number Plate Recognition (ANPR) technology should be used to enable access. Both services have a significant impact upon the experience of passengers with reduced mobility, removing the need to reach for a ticket.

For most passengers, entry to the vertiport will be uneventful, proceeding directly to the passenger acceptance touchpoint without delay. For passengers with reduced mobility, whether permanent or temporary, and passengers with non-visible disabilities, entry to the vertiport, and the journey throughout it, could be a stressful experience. Special assistance requests made either at the point of booking or ahead of travel will need to be shared with passenger assistance agents based within the vertiport. The importance of disability awareness training for passenger facing staff cannot be over-emphasised, to avoid the dehumanising experiences shared by our focus group participants.

Current legislation states that airport operators are responsible for the special assistance service provision[14]. If this legislation is extended to include vertiports, then roles and responsibilities and data sharing requirements will need to be well defined to ensure that passengers receive the support they require. However, all passengers should expect to be able to self-serve if they so choose, and this should be no different for passengers with reduced mobility and non-visible disabilities.

With the use of mobile devices and booking applications, if location services are enabled, opportunities exist for automated notifications between the passenger's device and the passenger services agent, to proactively notify them that a passenger requiring assistance is nearing the vertiport.

### 2.1.3 Passenger acceptance (Touchpoint T4)

Upon arrival at the vertiport a biometric image will be taken and compared to the database of expected passengers. A matching image will confirm that the passenger is at the right vertiport on the right day, at the right time. A subsequent check of the flight status will confirm that the flight is operating. Should any of these checks fail, a passenger service agent will be notified of the error and will be on hand to support the passenger.

Passengers and their baggage will be weighed, and the payload calculated. Once the weight of all passengers has been recorded, and that of the baggage to be placed in the hold, the flight operator will allocate seats to ensure the centre of gravity is within safe limits. Where baggage is oversized or overweight, there may be a requirement to transport it separately, in which case a mechanism will need to exist to send the baggage and enable it to be reunited with the passenger.

Instructions for passengers should be easy to understand and feature a combination of simple text and visuals that will also support non-English-speaking passengers. Audio cues might also exist for hearing impaired passengers.

Vertiports should also consider how they will support passengers who wear the Niqab or Burqa. Initial feedback has indicated that the presentation of a ticket and the ability for identity to be confirmed privately in the presence of female staff is an acceptable alternative to the seamless journey described in this document.



[14] Regulation (EC) No 1107/2006 of the European Parliament and of the Council of 5 July 2006 concerning the rights of disabled persons and persons with reduced mobility when travelling by air (Ref A2.6)

#### 2.1.3.1 Variations between use cases

### UC11 Sightseeing

The requirements of sightseeing passengers may differ from other passengers. For example, the speed of the process is likely to be slightly less important to a sightseer, who will be looking for a more enjoyable experience than a commuter and, as discussed earlier, sightseers are more likely to use a ticket than a biometric process to complete the passenger acceptance process. Sightseeing passengers are less likely to have hold baggage, therefore weight checks will likely be limited to the passenger and their hand luggage.

## 2.1.4 Security (Touchpoint T5)

In the absence of regulations governing the security of AAM, it is likely that operators will take a risk-based approach to determining the security activities required. In the early days, security checks may involve scanning passengers with a handheld wand and conducting a bag check, though this is still being determined.

An anticipated benefit of AAM in comparison to ground based forms of transport is a reduction in journey time. It will be necessary to ensure that the effort involved in security checks is commensurate with the risk to enable this benefit to be achieved.

Security considerations are discussed in more detail in Section 5 Safety and security.

#### 2.1.4.1 Variations between use cases

### UC10 Airport transport

While AAM is in its infancy, eVTOL passengers connecting to flights from an airport could be subject to two security processes, it will be important for passenger acceptance that they understand why this is necessary. Where the passenger is connecting to a flight, the vertiport could become an extension of the airport, with a security trust relationship between the two. In the future, and subject to an updated aviation security regime where the security activities within the vertiport are equal to that within an airport, it could be possible for a passenger to conduct all their security activities at the vertiport, landing airside at the airport ready for their connected flight departure.

## 2.1.5 Board the flight ready for take-off (Touchpoint T6)

Once the passenger has been accepted, they will enter the airside lounge area to await boarding. They will most likely only wait a few minutes before being notified that their flight is ready to board. Notification could be via screens located in the vertiport, audio cues, and via a notification to their mobile device.

In the early days of AAM and while flight numbers are low, the process of checking that the passenger is boarding the correct flight might be manual. In the future, to ensure a more seamless experience, a second biometric process is likely to confirm the identity of the passenger and that they are boarding the correct flight.

For safety, passengers will be accompanied from the vertiport to the aircraft, where ground handling staff will support them by loading any baggage into the hold and, for disabled passengers, assist them to board the aircraft. Passengers who are neurodiverse might be given the opportunity to board first so that they have time to 'ground', becoming familiar with their environment and reducing potential anxiety.

The pilot will be responsible for checking that the number of bags loaded into the hold matches the baggage manifest, to ensure the aircraft payload and centre of gravity are not compromised.

The pilot will ensure passengers receive a safety briefing before the eVTOL takes-off. This could be delivered to passengers via their own mobile devices, with passengers required to confirm that they have received and viewed the briefing before the eVTOL is permitted to depart.

### 2.1.6 Arrive at the destination vertiport (Touchpoint T7)

Once the passenger has disembarked and made their way to the vertiport, accompanied by vertiport staff, they will either exit the building or, where catching a connecting flight, will enter the departure lounge. To avoid a repetition of passenger acceptance, weight checking and security processes, the data captured at the departing vertiport will need to be shared with the arrival vertiport and the operator of the connecting eVTOL service. This will enable a biometric process to gain entry.

For passengers who have requested special assistance, the data will need to be shared with the destination vertiport to ensure continuation of service for the passenger.

## 2.2 Process exceptions and use of technology

### 2.2.1 Possible process exceptions

The 'happy day' process described in Section 2 The passenger journeyThe consumer vision for 2030 set out in the UKRI Future Flight Vision Roadmap describes how new classes of air vehicles will benefit consumers and sets out the societal, environmental, and economic goals. Anticipated benefits include improvements in access to services and employment opportunities for those with reduced mobility, and a predicted 1.8% increase in GDP with 628,000 jobs supported.

In data published by the Department for Work and Pensions (DWP) in October 2023, it was reported that nearly one in four of the working age population are classed as disabled, and therefore there is the potential for people with disabilities to represent a significant proportion of AAM service users.

The Government's 2019 manifesto committed to empowering and supporting disabled people. A goal to achieving this is to close the disability employment gap (the difference between the number of disabled people in work compared to the number of non-disabled people).

In 2021, the government published the National Disability Strategy, setting out the actions it will take to improve the everyday lives of all disabled people. The strategy notes that we all want to live "fulfilling lives", to "live an independent life", and to "participate in society, to be valued, to go to work". However, for many disabled people, their everyday experience is very different to that of non-disabled people, presenting barriers to achieving what most would consider commonplace aspirations.

Transport policy is recognised as having a part to play in improving lives, and the strategy acknowledged that while the Department for Transport's (DfT) Inclusive Transport Strategy has "helped to accelerate progress", "challenges are often significant" and "there is still a lot to do".

In February 2024, Advanced Mobility Ecosystem Consortium (AMEC) members hosted a disability focus group, to explore the lived experiences of disabled people in the context of public transport, and to share thinking around the AAM passenger journey. The overriding lesson from participants was that inclusion is for everybody. They called for an attitudinal change: for inclusion to be considered as a norm, not a special accommodation. Participants felt that designing inclusive services would make travel experiences better for everybody, not just disabled people.

Participants remarked on weaknesses in the current policy environment preventing the realisation of inclusive travel, and saw an opportunity for policy-makers to embed the requirements of disabled people into this novel form of transport from the outset, "potentially revolutionising inclusive travel by setting an exemplar for all other modes of transport".

According to Scope, a leading disability equality charity in England and Wales, and research published by Purple, in 2020 the collective spending power of disabled people and their households was estimated to be worth £274 billion per year to UK business with a loss to transport providers of £42 million per year by not being accessible.

We call upon policy-makers and AAM operators in the public transport space to use this unique opportunity to put inclusivity at the heart of service design, and to lead the way in improving the lives of all disabled people.

Though this document does not provide comprehensive accessibility design solutions, we highlight where opportunities exist to make touchpoints accessible, and welcome suggestions from anyone with an interest in this subject.

The passenger journey excludes possible process exceptions, where a passenger is unable to pass immediately and smoothly through the touchpoints and requires additional processing.

Some examples of exceptions are as follows:

- Logistical exceptions (e.g., the passenger arrives too early and/or at the wrong vertiport, or their specific flight has been cancelled).
- Security exceptions (e.g., the passenger is in possession of an item that cannot be carried on the eVTOL aircraft).
- Identity exceptions (e.g., the passenger cannot use biometrics or chooses not to do so).
- IT exceptions (e.g., the passenger loses their mobile device, or it runs out of battery; or wired or wireless networks are unavailable).
- Other exceptions (e.g., a family group includes young children. Providers of automated gates advise against use by young children, and children and parents are unlikely to accept being physically separated, even for a short time).

### 2.2.2 The role of technology

The ‘happy day’ passenger journey process is enhanced by a maximal use of technology already used in large-scale commercial aviation, such as mobile devices, biometrics, and automated gates. Whilst the use of these technologies will provide cost, efficiency, and security benefits, it is not necessarily essential to implement all feasible technologies at the first few active vertiports:

1. Widespread use of mobile devices is probably likely from ‘day one’ given their ubiquity. Use of paper documents such as boarding passes and proof of identity may also be required, for exceptional circumstances. Each of these modes has (different) implications for both infrastructure and processes.
2. In principle, and on a small scale, manual identity checks could be performed by a member of staff at every touch point without using biometrics at all. A hybrid solution for domestic-only travel might be to use biometrics within the vertiport but not in advance of arrival. Section 3 Identity and biometrics explores the use of biometrics in further detail. In the longer-term, a completely unstaffed vertiport is perhaps still some years away but might be introduced in parallel with autonomous eVTOL aircraft (see also Section 8.2 Autonomous flight and vertiport operations).
3. Although turnstile-type gates can save staff costs and smooth passenger flows by providing self-service options, initial cost of purchase may require some economies of scale and could exclude some passenger demographics.

# 3. Identity and biometrics

Identity Management using biometric technology is a key enabler of a seamless passenger journey. It has been widely and successfully deployed in airports globally to improve the efficiency of passenger processing, increase security, and help reduce operational expenditure. Face recognition is the most used biometric technology and would be appropriate for AAM.

Use extends beyond airports. In July 2023, Eurostar introduced the use of 'SmartCheck' a facial biometric check-in system at London St Pancras International[15]. The system enables Business Premier or Carte Blanche passengers to download an application that will scan their passport and verify their identity to create a digital ID, associating the identity with the ticket. On arrival, passengers can proceed through a dedicated SmartCheck corridor, with a walk-past facial biometric checkpoint enabling them to avoid queues for ticket and UK border exit checks.

Whilst the number of passengers travelling through vertiports is not comparable to that of airports, the benefits realised through the deployment of these technologies should appeal to passengers, vertiport operators and flight operators alike. Examples of benefits include a reduction of staff numbers required in the vertiport, less time spent queuing, and a better passenger experience leading to repeat custom; and security enhancements reducing the number of disruptions to business-as-usual operations.

## 3.1 What are biometrics?

Biometrics use the inherent physical characteristics unique to an individual to answer one or both of the following questions: "are these two people the same?" and "have I seen this person before?" Hardware devices such as cameras are used to capture biometrics, which are converted to a form allowing computers to compare them – a biometric template – and hence used to distinguish one individual from another.

## 3.2 Why use biometrics?

A key characteristic of an effective biometric system is that it operates consistently. A suitably performant and appropriately configured biometric solution should give the same result to any given comparison of two individual people; it does not get tired after a period of time, get distracted by what clothes people are wearing or how they are behaving, and will not become otherwise influenced.



[15] Eurostar Rolls Out 'SmartCheck' Facial Biometric Check-In System (Ref A2.1)

## 3.3 Why face recognition?

Many different types (modalities) of biometric are used worldwide; the most common are face, fingerprint, and iris recognition[16]. No single biometric modality is inherently “best”; each modality has strengths and weaknesses, many of which are dependent on how and where that modality is being used. Some reasons why face recognition is likely to be suitable for use in AAM are listed below:

1. Face recognition is already widely used in large-scale commercial aviation, and travel documents such as passports contain facial images captured to internationally recognised standards.
2. Faces are human-recognisable and so can be used in manual exception processes (unlike, for example, fingerprints; see also Section 2.2 Process exceptions and use of technology).
3. Faces can be easily captured and compared using mobile devices (unlike, say, irises).
4. Use of face recognition is generally accepted to some degree in UK, noting the need for data privacy (see also Section 7 Data protection).

## 3.4 What are the limitations?

No biometric modality is a ‘silver bullet’ that can match 100% of people: for example, face recognition is less likely to work effectively for people wearing dark glasses; fingerprint matching may not work well for manual workers. Humans are superb at recognising familiar faces and/or performing small numbers of matches, but their face-matching effectiveness will typically reduce drastically after only a few minutes. The optimum approach probably uses biometrics for most transactions which are clear-cut (i.e., either definitely the same person, or definitely not); and human decision-making when a match is either not certain or not possible.

Using inherently capable biometric technology is necessary but not sufficient for an effective real-world solution; it must also be implemented and configured appropriately[17]. Real-world trade-offs can be made between accuracy, speed, passenger experience and cost. For example:

- Taking more images during capture enables greater certainty of match but takes longer.
- Asking a passenger to remove (for example) their glasses during image capture may improve performance (speed and/or accuracy) but be perceived as a less seamless passenger experience.



[16] Biometrics Institute: Types of Biometrics (Ref A4.1)

[17] Biometrics Institute: The Three Laws of Biometrics (Ref A4.2)

An important point to note is that, unlike a password or PIN, an individual's biometrics inherently cannot be permanently changed; this reinforces the need to store and transfer them securely (see Section 7 for further details).

## 3.5 What is identity management?

As noted above, at any given point in a journey the capture and comparison of biometrics can confirm whether this is a specific individual, or one of the people expected to use the vertiport, but not who the passenger is, or whether they are entitled to proceed onto an eVTOL flight. As the name suggests, identity management links a person's inherent identity to wider information, potentially including a travel document (e.g., a boarding pass linked to their journey), and an identity document (e.g., a personal digital identity shared via an app on a mobile device such as a smartphone).

## 3.6 The role of biometrics and identity management in domestic transport

If you read online forum or news article comments on the topic of identify management in the domestic travel industry, you will note that it is contentious. A recent example is the change in British Airways policy[18], to mandate rather than recommend domestic passengers travel with a form of photographic ID. British Airways has not communicated what has prompted the change and the CAA has confirmed that it not in response to any regulatory change. Where the need for change is unclear, public acceptance of a change is likely to face resistance.

**People are protective of sharing identity information. To support the successful adoption of AAM, if passengers are required to share their ID, they must understand why and how it is used.**

In the production of this document, effort has been taken to understand the need for passengers to provide a form of official photo ID. The conclusion is that airlines operating domestic flights within the UK mandate that passengers provide photo ID for commercial reasons. Providing photo ID prevents passengers from passing their ticket to another person without incurring a fee to officially transfer the ticket.

It is noted, both through feedback from travellers interviewed as part of the research for this report, and from online forums, that processes vary from one airport and operator to another. At some airports, passengers may complete the entire journey without being asked to present their photo ID, and there are stories of passengers travelling on a ticket that is not in their name. It is the discrepancy between airline policy and operations that prompts questions around the need for photo ID and presents a challenge to public acceptance.



[18] British Airways changes policy to require photo ID for UK domestic flights | The Independent (Ref A2.7)

There is no regulatory requirement for ground-based domestic transport operators to check the ID of passengers. It is only where rail passengers are using a season ticket or railcard that a rail operator will check photo ID. It should be noted that this ID, issued by the rail operator, is not verified against an official form of ID, for example a passport or driving licence, to confirm that they are who they say they are, it simply enables a visual check that the passenger holding the ticket is the same as the person associated with the ticket. Given the volume of rail passengers and the relatively low cost of 'general sale' rail tickets, checking ID to prevent the transfer of those tickets would likely prove a costly and therefore unviable process for operators.

There is also no regulatory requirement for ground-based domestic transport operators, to maintain a passenger manifest, something all flight operators are expected to maintain. In the event of an accident, a flight operator is required to submit this data to the Air Accident Investigation Branch (AAIB) within two hours of notification of the accident[19]. Checking passengers' ID would ensure the accuracy of the manifest, however, highlighting the rationale is unlikely to provide comfort to a nervous passenger. With air travel the safest form of travel[20], domestic airlines are likely to take a risk-based and 'by exception' approach to operations, and consider that time saved by not performing an ID check outweighs the risk of an inaccurate passenger manifest – if the passenger headcount matches the number of passengers expected, the manifest is likely to be correct. In the early days of AAM, flight operators may decide that until the safety track record is built-up, ensuring an accurate passenger manifest is critical. Biometrics will be crucial to the efficiency of this process.

Passengers travelling infrequently, those members of the population who are less "tech savvy", and those who do not see a need to manage a digital ID and are protective of their personal data, will likely feel the need to create and maintain one for the purposes of the occasional efficient journey is excessive and introduces an unnecessary security risk to their personal data. They are also likely to feel dissatisfied if the process of accessing their ticket is delayed by the need to provide proof of identity, and for operators to verify their ID. It is crucial when considering the security regime of AAM, of which identity management is a part, the purpose of identity data, how it will be used and how it will benefit passengers is understood. In the future, where digital ID is widely adopted, while some passengers may choose to share their personal data for their own convenience, unless security demands it, this cannot be a mandatory requirement.

If it is deemed necessary that passengers share an official form of identity, then to enable public acceptance and the successful adoption of AAM, it is important that passengers understand why. If operators insist upon the provision of ID with no legal basis, they risk driving passengers away. If by 'sharing ID' we simply mean associating



[19] Aircraft Accidents and Serious Incidents: Guidance for Airline Operators (publishing.service.gov.uk) (Ref A2.8)

[20] Aviation safety | Civil Aviation Authority (caa.co.uk) (Ref A2.9)

an image with the booking so that the passenger does not need to present their ticket at the vertiport, this is far more likely to be accepted.

## 3.7 Who owns and shares the identity data?

Fundamentally, the passenger owns their own biometric data. However, in the short term – as evidenced by the Eurostar application in which the passenger is managing their digital identity – if other travel operators introduce similar systems, it is possible that the passenger could be managing multiple applications and digital identities.

"ID as a Service" (IDaaS) solutions exist, which enable a single verified digital ID that a person can share with different service providers for many purposes, e.g. the setting up of a bank account, a mortgage application, conveyancing, and, in this scenario, to achieve a much more convenient and seamless journey through vertiport and onto their eVTOL flight (and, in the future, for their onward domestic or international journey). This will remove the need to create and maintain IDs with many service providers and the inherent risks associated, e.g. cyber-attacks. The only limitation is the acceptance of the IDaaS solution by the service provider.

The sharing of biometric data will be enabled using a mobile device app; the storage, usage and management of that data will need to be carefully managed in accordance with UK GDPR as described in Section 7 Data protection (below)[21].

## 3.8 Social acceptance of IDaaS

The uptake of IDaaS solutions may vary from country to country, as might trust in such solutions. Passenger and operator trust might depend upon the levels of IDaaS governance adopted within a country, and the extent to which the quality and the security of the IDaaS data can be assured. Additionally, passenger attitudes to the sharing of identity data might be shaped by things such as the history of the country of which they are resident or the age of the passenger.

The UK Government is developing the UK digital identity and attributes trust framework[22] to support the use of secure trusted digital identity products in the UK.

While IDaaS providers can validate an identity through non biometric forms, the process of doing so is more time consuming than when validating a biometric form of identification, and passengers will need to take this into account should the need to



[21] Biometrics Institute: Ethical Principles for Biometrics (Ref A4.3)

[22] UK digital identity and attributes trust framework beta version (0.3) – GOV.UK (www.gov.uk) (Ref A4.4)

share a digital identity become necessary for travel. As of April 2021, 13.5% of the population in England and Wales, and 15.9% in Northern Ireland[23], did not hold a current passport[24]. In 2019, 71% of adults (aged 17+) in Scotland[25] and 75% in England[26] held a driving licence. If eVTOL travel is to be accessible and equitable regardless of age, gender, race, ethnicity, disability and more, then it will be necessary to ensure barriers are not introduced, and that where identity management and other activities are determined to be mandatory, other mechanisms exist to address the need.



[23] Census 2021 update | Northern Ireland Statistics and Research Agency (nisra.gov.uk) (Ref A4.5)

[24] Passports held by age – Office for National Statistics (ons.gov.uk) (Ref A4.6)

[25] Motor vehicles, traffic and driving | Transport Scotland (Ref A4.7)

[26] Driving licence holding and vehicle availability – GOV.UK (www.gov.uk) (Ref A4.8)

# 4. Interoperability in the AAM industry

Many channels exist for passengers to search for and purchase travel: through online databases such as Skyscanner or National Rail Enquiries; directly with operators via their websites and booking applications; operator call centres; through online and high street travel agencies; through ticket desks or self-service machines at rail and bus stations, etc. When planning travel, ease of use, clarity and transparency are key components to a positive passenger journey[27] regardless of the method of travel[28].

Having booked travel, accessing information in a single place is important. Operator applications can provide passengers with a range of functionality, from enabling the purchase of tickets for multiple modes of transport, to reminding passengers where they parked. However, passenger stakeholders engaged by the AMEC consortium spoke of their frustration at the number of applications required to enable travel, in particular the multitude of apps required for electric car charging across the road network and for car parking.

Collaboration between AAM and other transport operators will be crucial to ensuring passengers are at the heart of the travel industry, and key to the delivery of a seamless passenger journey. Developing a centralised database of scheduled eVTOL flight bookings will enable passengers to see all the options that are available to them from one place, driving competition between operators for the benefit of passengers.

Below we look at how other travel industries collaborate for the benefit of passengers and operators.

## 4.1 Transparency and interoperability in the rail industry

Regional rail operators in the UK work together as part of the Rail Delivery Group[29] with the aim of “creating a railway that delivers real improvements in customer experience, which drives growth in both the number of customers and the number of journeys and



[27] Global_Passenger_Survey_2022_Highlights_iata.org.pdf (Ref A2.10)

[28] Transforming rail travel – Feb 2022 (Ref A2.11)

[29] About (raildeliverygroup.com) (Ref A2.12)

allows us to create a simpler and better railway." Key to this is transparency[30] and putting more information in the public domain. Operator timetables are shared, and the group enables programme developers to access data through Application Programming Interfaces (APIs) and Extensible Markup Language (XML) feeds, enabling the creation of applications that enrich the service offering to passengers to drive growth in the industry.

While regional rail operators may have their own booking applications, it is possible for passengers to use these to book tickets on services provided by other operators. This is in accordance with Regulation (EC) No 1371/2007 of the European Parliament and of the Council of 23 October 2007 on rail passengers' rights and obligations[31]. For regular passengers travelling on more than one network, this removes the need to download multiple applications and to maintain personal data in many accounts.

## 4.2 Interoperability in the aviation industry

In aviation, Global Distribution Services (GDS) exist to enable travel agents and tour operators' access to the inventories and fares of travel operators across the world. This includes flights, hotels, and car rental companies, providing a one-stop shop. These, and voluntary "interlining agreements" between airlines, enable a passenger to book flights for one airline through another, and for check-in and baggage handling to be undertaken by one operator on behalf of another. An example is where a multi-leg journey comprises of flights with multiple flight operators.

The aviation industry is well used to collaborating for the benefit of passengers. The International Air Transport Association (IATA)[32] – representing 300 airlines and 83% of the world's total air traffic – works with airlines, regulators and governments, and leads the development of global commercial standards within the air transport industry. It enables interoperability of service provision and increasing passenger convenience while reducing costs and improving efficiencies.



[30] Transparency (raildeliverygroup.com) (Ref A2.13)

[31] Guidance on rail passengers' rights and obligations: regulation No 1371/2007 (Ref A2.14)

[32] IATA – Mission & Vision (Ref A2.15)

# 5. Safety and security

Ensuring passengers feel safe and secure will be a key component in the social acceptance of AAM. Studies undertaken as part of the Future Flight Challenge and within AMEC around public understanding and social acceptance explore these topics.

Key findings from the Social Desirability Report[33] produced by Connected Places Catapult on behalf of AMEC, indicated that "participants [in the study] were concerned about crashes in the air, eVTOLs falling from the sky, being targeted by cyber threats, gunned down from the sky, or used for terrorist attacks".

While participants identified speed of travel as a benefit of eVTOL transport they identified that, if security checks were similar to those in airports, overall time savings would be lost rendering it less desirable. Nonetheless, participants noted a physical threat and a need to prevent weapons being carried on board, as well as the threat posed by cyber hacking.

Feedback from participants suggested that they would feel more safer and more secure, and be less concerned about security checks, where they were travelling with passengers known to them. Some participants advised that they expect some form of baggage and personal security check, and that that this would provide assurance that they are safe. While some suggested that a requirement to provide ID gives some assurance, there is an incorrect assumption that this provision results in some form of check on the passenger. Research conducted as part of this project tells us that this is not the case, and that domestic flight operators do not conduct any form of security check on their passengers. Participants considered that checks that baggage and persons are not carrying offensive items were more important.

The findings of the Social Desirability Report are somewhat reflected in the findings of the UKRI and Sciencewise-funded report, Future Flight Challenge: mini public dialogue, conducted by Ipsos with support from The Liminal Space[34]. Participants' leading concern was the risk of collision in the air which was seen as more alarming than road collisions due to the risk to people and property below. Mechanical accidents, human error and cyber security risks were prominent concerns.

For automated or remotely piloted vehicles, a 2030 capability described in the Future Flight Vision Roadmap, malfunction or hacking was felt to be a risk because of the lack of human presence to manually remedy the situation. For piloted vehicles, the risks identified included inadequate pilot training, health concerns or incapacitation due to



[33] AMEC Social Desirability Report, July 2023 (Ref A1.4)

[34] Future Flight Challenge – Mini Public Dialogue, June 2022 (Ref A1.5)

alcohol or drugs. Participants saw automated vehicles as more open to hijacking than manually controlled vehicles.

While safety and security of AAM are important aspects of the passenger journey, identifying the mechanisms to provide assurance, on which the journey is dependent, are largely outside of the scope of AMEC. An exception is cyber security of the vertiport operational technology which is considered in the Cyber Security Strategy[35] developed by AtkinsRéalis on behalf of the consortium.

Outside of the consortium, AMEC members are engaging with the Department of Transport and the Civil Aviation Authority (CAA) around the future model for safety and security of AAM: we await news on proposed regulation. In the meantime, it is assumed that operators will take a risk-based approach to determining the security activities required. In the early days, security checks may involve scanning passengers with a handheld wand and conducting a bag check, progressing to something more automated as passenger numbers increase to avoid waiting time. When considering the risks, flight operators will not only have a duty of care to their passengers but also to their employees, vertiport ground handling staff, as well as the public who may be impacted by an incident.



[35] Future of Flight Challenge – Cyber Security Strategy, July 2023 (Ref A1.6)

# 6. Data exchange

Understanding the flow of data throughout the passenger journey helps define the requirements of systems and roles of stakeholders involved. This section introduces the challenges associated with exchanging data, the stakeholders involved, outlines the categories of data exchanged and maps out the flow of data throughout the passenger journey. Data protection regulations associated with the processing of data, another key consideration, is covered separately in Section 7 Data protection.

## 6.1 The challenge

At each stage of the passenger journey, data needs to be shared with one or more of the stakeholders involved. Understanding what data should be exchanged, when the exchange should take place, and who should be involved requires careful consideration. Should this not happen, inefficiencies associated with the storage and exchange of data will lead to the duplication of identity checks, causing disruption to passengers.

The aviation industry has faced a similar challenge with the implementation of One ID, a transformation programme with aspirations to create an end-to-end passenger experience that is secure, seamless, and efficient. The major issue facing the successful implementation is the lack of trust in the accuracy of passenger data, and the unwillingness of organisations to share data with each other[36]. The data flows described in this paper aim to process and store the minimum amount of personal data required to achieve the desired outcome.

Establishing trust between stakeholders involved in the vertiport passenger journey is crucial to successful implementation of any solution. Having confidence in the accuracy of data, and the ability of stakeholders to securely share and store data, will prevent disruption and improve the passenger experience. To achieve a high level of data sharing between stakeholders, systems should be interoperable and designed with open architecture features. This will also make it easier to add upgrades and new components as technology advances[37] [38] [39] [40].



[36] openaccessgovernment.org: The challenges of data security and queues at airports (Ref A1.7)

[37] airport-technology.com: Open Architecture – a new Vision for Airport Security (Ref A5.1)

[38] ACI Europe: Open Architecture for Airport Security Systems (Ref A5.2)

[39] BCS: What is Interoperability? (Ref A5.3)

[40] Passenger Terminal Today: Interoperability – the Key to a Seamless Journey (Ref A5.4)

## 6.2 Stakeholders

The key stakeholders involved in the vertiport passenger journey are listed in Table 6-1 – Passenger journey stakeholders. Future eVTOL operations could include IDaaS providers, and government agencies such as the Home Office and Border Force. These stakeholders have not been included in this report, as they fall outside its scope.

| Stakeholder | Definition |
|---|---|
| Passenger | A person with a valid booking for travel on an eVTOL flight. Travelling for either business or leisure, they will arrive at a vertiport on the day of travel and undergo several checks before departure. |
| Flight Operator(s) | The company responsible for providing eVTOL services to travelling passengers. This includes all activities related to flight scheduling, booking and operation. |
| Vertiport Operator(s) | The company responsible for the operation and maintenance of a vertiport. eVTOL services arrive and depart from their facility, for which they are responsible for the day-to-day management. |

**Table 6-1 – Passenger journey stakeholders**

## 6.3 Data categories and ownership

Several categories of data are involved in exchanges between stakeholders. Each category is owned by one stakeholder, and used by one or more stakeholders through the passenger journey to provide information about the scheduled eVTOL flight or improve the passenger experience.

The data category and owner will impact the implementation of the data protection regulations that need to be adhered to. Section 7 provides an overview of these regulations, as well as the controls and measures that can be implemented to meet the necessary requirements.

The key categories include:

1. Passenger personal data: identity (e.g., name, photo, biometrics) and non-identity (e.g., weight).
2. Individual passenger booking, aggregated into the passenger manifest for a given eVTOL flight.
3. Passenger live status (as a passenger moves through the vertiport and completes necessary checks).

The flow of data items in these categories during the passenger journey is shown diagrammatically in Figure 6-1 – Passenger Journey Data Flow – Touchpoints 1 to 4 and Figure 6-2 – Passenger Journey Data Flow – Touchpoints 5 to 7 (overleaf), followed by a detailed description in Table 6-2 – Passenger journey data flow.

## 6.4 Passenger journey data flow diagram

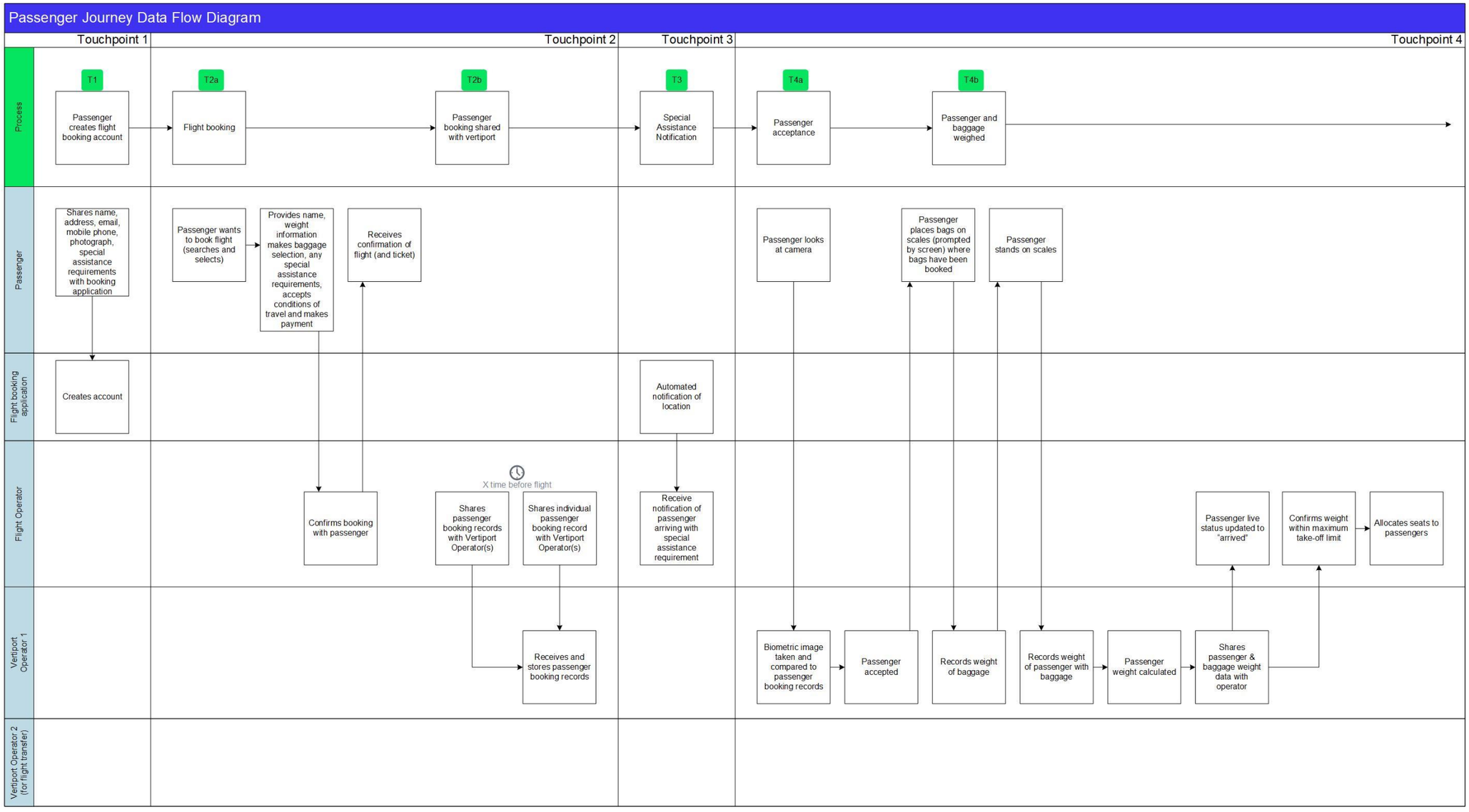


**Figure 6-1 – Passenger Journey Data Flow – Touchpoints 1 to 4**

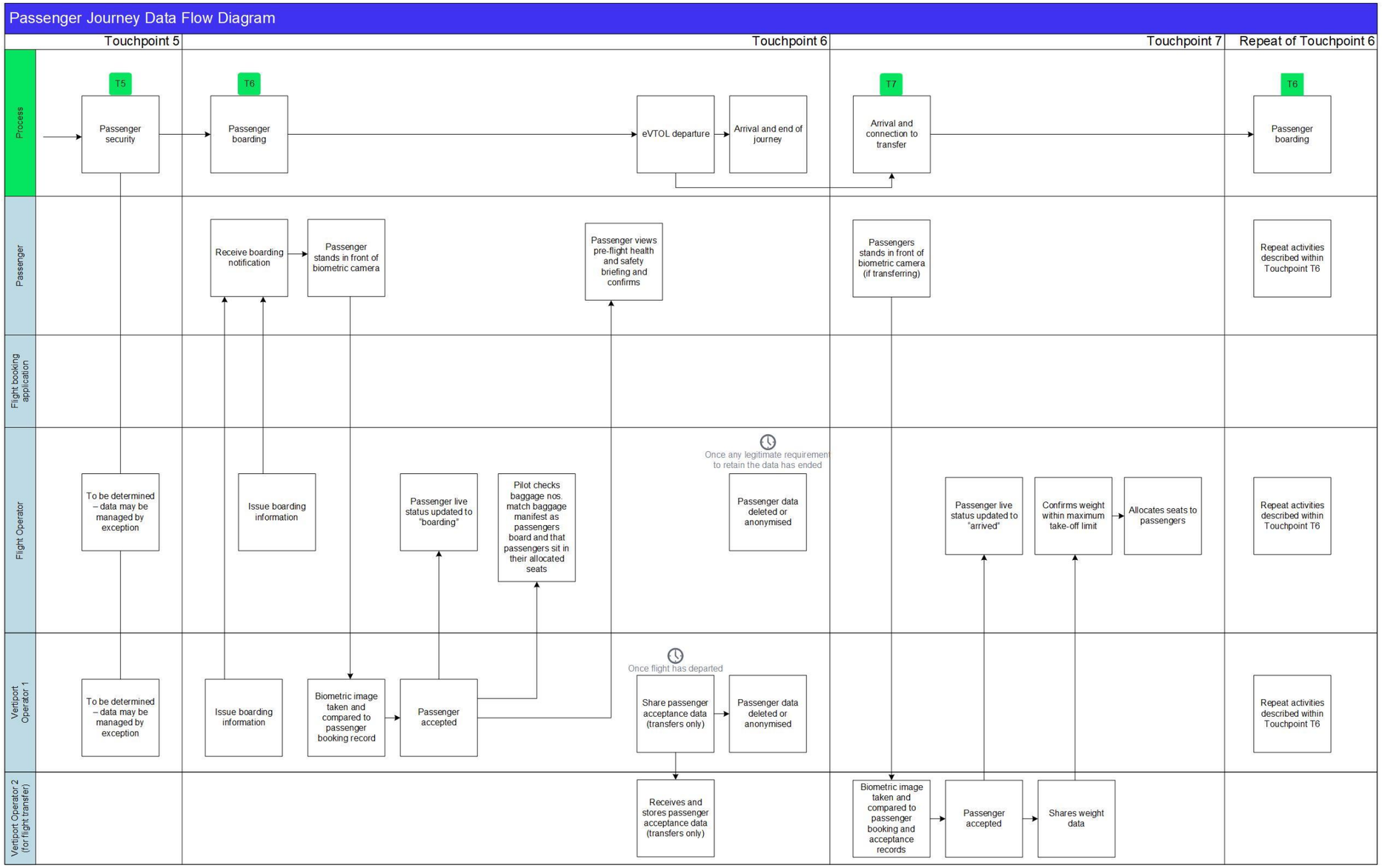


**Figure 6-2 – Passenger Journey Data Flow – Touchpoints 5 to 7**

## 6.5 Passenger journey data flow table

Table 6-2 – Passenger journey data flow provides a more detailed overview of the passenger journey data flow illustrated in Figure 6-2 – Passenger Journey Data Flow. For each process, it outlines the data exchanged, the sender of data, the receiver of data, the purpose of the exchange and the sequence in which it happens.

| Touchpoint/ **Process** | **Data** | **Data Origin** | **Data Destination** | **Purpose** | **Sequence** |
|---|---|---|---|---|---|
| T1 – Passenger creates flight booking account | ▪ Passenger name*<br>▪ Passenger address<br>▪ Passenger email*<br>▪ Passenger mobile number*<br>▪ Adult or child<br>▪ Age if child<br>▪ Passport-style selfie image<br>▪ Special assistance requirements<br>▪ Payment details<br>▪ Acceptance of account terms and conditions*<br>*Mandatory information | Passenger | Flight booking application | Enables passenger to save regular journey information and complete booking information more efficiently | 1. Passenger provides information required to create account<br>2. Passenger captures facial images using a mobile device<br>3. Passenger agrees to terms and conditions for the account |

| Touchpoint/ **Process** | **Data** | **Data Origin** | **Data Destination** | **Purpose** | **Sequence** |
|---|---|---|---|---|---|
| | ▪ Account confirmed | Flight booking application | Passenger | Confirms that account has been created | 1. Confirmation of successful account set-up |
| T1 – Passenger sets application preferences | ▪ Location services<br>▪ Notification settings | Passenger | Flight booking application | Allows location sharing for passengers requiring special assistance at Touchpoint T3<br><br>Allows the passenger to receive notifications in advance of, and during, their journey | 1. Passenger enables sharing of location data<br>2. Passenger agrees to receive notifications and the method of notification |
| T2a – Flight booking | ▪ Passenger name<br>▪ Passenger image (from account) | Passenger | Flight operator | Allows flight operator to confirm the correct passengers board the correct flight and facilitates a seamless journey. | 1. Passenger enters name when booking flight<br>2. Passenger confirms use of image for seamless travel |

| Touchpoint/ **Process** | **Data** | **Data Origin** | **Data Destination** | **Purpose** | **Sequence** |
|---|---|---|---|---|---|
| | ▪ Special assistance request | Passenger | Flight operator | To enable the flight operator to plan for and provide the support required by the passenger | 1. Passenger provides details of the assistance they require<br>2. Flight operator receives and acts upon request |
| | ▪ Conditions of carriage (weight limits, sharing passenger info with vertiport) | Flight operator | Passenger | Highlights requirements for travel, provides confirmation of booking and the information required to board eVTOL. | 1. Passenger reviews conditions of carriage |
| | ▪ Passenger agrees to conditions of carriage (within weight limit, sharing passenger information with vertiport | Passenger | Flight operator | Confirmation that the passenger has accepted the conditions of carriage | 1. Passenger agrees to conditions of carriage |
| | ▪ Passenger weight<br>▪ Passenger baggage | Passenger | Flight operator | To enable estimation of flight payload and | 1. Passenger selects their weight range<br>1. Passenger selects the number and profile of |

| Touchpoint/ **Process** | **Data** | **Data Origin** | **Data Destination** | **Purpose** | **Sequence** |
|---|---|---|---|---|---|
| | | | | avoid refusal on arrival at vertiport | baggage they will be travelling with |
| | ▪ Passenger payment details | Passenger | Flight operator | To secure booking and receive ticket | 1. Passenger enters payment details<br>2. Passenger completes booking process |
| | ▪ Ticket<br>▪ Flight information (date, time, location) | Flight operator | Passenger | Provides passenger with information required to board eVTOL flight. | 1. Ticket generated<br>2. Flight information sent to passenger |
| T2b – Passenger booking shared with vertiport | ▪ Passenger name<br>▪ Passenger image<br>▪ Passenger flight information (date, time, location (start and end))<br>▪ Passenger baggage numbers and profile | Flight operator | Vertiport operator | Vertiport operator need to know which passengers to expect on a given day. It allows them to conduct the required identity checks and weight capture to process passengers through the vertiport. | 1. Information will be shared as part of a batch passenger manifest, likely to be sent ~24 hours before departure<br>2. If passenger books <X time before flight, an individual passenger booking will be shared |

| Touchpoint/ **Process** | **Data** | **Data Origin** | **Data Destination** | **Purpose** | **Sequence** |
|---|---|---|---|---|---|
| | | | | | 3. Vertiport operator receives passenger information |
| T3 – Special Assistance Notification | ▪ Passenger name<br>▪ Special assistance request | Flight booking application | Flight operator | Flight operators need to know when to provide special assistance requests | 1. Information could be shared as passenger is within X distance of vertiport |
| | ▪ Welcome message | Flight operator | Passenger | Flight operators can acknowledge that they are aware and will be on hand to support to reassure the passenger | 1. Flight operator confirms notification received<br>2. Passenger receives welcome message with instructions (if needed) |
| T4a – Passenger acceptance | ▪ Facial images | Passenger | Vertiport operator | Vertiport operator needs to confirm passenger is at the correct vertiport at the correct time. The passenger's identity is matched with the data | 1. Passenger image is captured and matched with image in passenger booking records<br>2. Retrieve boarding pass data<br>3. Confirm validity of boarding pass |

| Touchpoint/ **Process** | **Data** | **Data Origin** | **Data Destination** | **Purpose** | **Sequence** |
|---|---|---|---|---|---|
| | | | | in the passenger records. | 4. Check flight status<br>5. Confirm flight status<br>6. Scales triggered |
| T4b – Passenger and baggage weighed | ▪ Passenger weight<br>▪ Baggage weight | Passenger | Vertiport operator | Vertiport operator needs to record the weight of the passenger and their baggage | 1. Baggage weight captured<br>2. Passenger and baggage weight captured<br>3. Passenger weight calculated<br>4. Gate opens for passenger to enter lounge area |
| | ▪ Passenger status changed to ‘arrived’ | Vertiport operator | Flight operator | Flight operator is aware of the location of the passenger | 1. Passenger live status updated |
| | ▪ Passenger name<br>▪ Passenger weight<br>▪ Baggage weight | Vertiport operator | Flight operator | Vertiport operator systems need to calculate the payload and centre of gravity | 1. Total payload calculated<br>2. Confirm maximum take-off weight is not exceeded |

| Touchpoint/ **Process** | **Data** | **Data Origin** | **Data Destination** | **Purpose** | **Sequence** |
|---|---|---|---|---|---|
| | ▪ Passenger flight information (date, time, location (start and end)) | | | to confirm the eVTOL is safe to fly | 3. Allocate seats to passengers |
| T5 – Passenger security (to be determined with data likely handled by exception) | ▪ Passenger name (failure only)<br>▪ Reason for failure | Vertiport operator | Flight operator | Flight operator is able to de-log passenger where a serious breach of security occurs | 1. Remove passenger from flight<br>2. Record the reason for failure |
| T6 – Passenger boarding | ▪ Boarding status<br>▪ Seat allocation | Flight operator/ vertiport operator | Passenger | Notifies passenger that the flight is ready to board and their seat allocation | 1. Passenger receives mobile device notification<br>2. Notification also available on screens and by audio.<br>3. Passenger makes their way to boarding gate |
| | ▪ Passenger image captured | Passenger | Vertiport operator | Vertiport operator needs to confirm passengers are boarding the right | 1. Passenger image is captured and matched with image in passenger booking records |

| Touchpoint/ **Process** | **Data** | **Data Origin** | **Data Destination** | **Purpose** | **Sequence** |
|---|---|---|---|---|---|
| | | | | aircraft on behalf of the flight operator | 2. Confirmation passenger is boarding the correct flight |
| | ▪ Passenger live status changed to ‘boarded’ | Vertiport operator | Flight operator | Flight operator is aware of the location of the passenger | 1. Passenger passes through boarding gate<br>2. Passenger live status updated |
| | ▪ Passenger baggage<br>▪ Seat allocation | Flight operator/ vertiport operator | Pilot | Pilot needs to confirm that the hold baggage matches the baggage manifest, and passengers are seated in their allocated seats to assure the aircraft’s centre of gravity | 1. Pilot checks off baggage against baggage manifest as passenger boards<br>2. Pilot checks passengers are seated correctly |
| | ▪ Confirmation of pre-flight health and safety briefing | Passenger | Pilot | Pilot needs to confirm that passengers have received and viewed the pre-flight health & safety briefing | 1. Passenger views briefing<br>2. Passenger confirms briefing viewed |

| Touchpoint/ **Process** | **Data** | **Data Origin** | **Data Destination** | **Purpose** | **Sequence** |
|---|---|---|---|---|---|
| | | | | | 3. Pilot notified that all passengers have confirmed |
| | ▪ Passenger data associated with the booking | Vertiport operator 1<br><br>Vertiport operator 2<br><br>Flight operator | Deleted or anonymised | To comply with the Data Protection Act 2018 and the retention and disposal of personal data | 1. Data deleted or anonymised once retention rules are met |
| T7 – Arrival at destination vertiport, where passenger is transferring to a connecting flight | ▪ Passenger name<br>▪ Passenger ticket details<br>▪ Passenger weight<br>▪ Baggage number and weight<br>▪ Special assistance requirements | Vertiport operator 1 | Vertiport operator 2 | Avoid passenger having to repeat acceptance and weight collection processes | 1. Information will be shared once originating flight has departed<br>2. Vertiport operator 2 receives passenger information |
| | ▪ Passenger image captured | Passenger | Vertiport operator | Vertiport operator needs to confirm to passenger all required data has been received | 1. Passenger image is captured and matched with image in transferring passenger booking records |

| Touchpoint/ **Process** | **Data** | **Data Origin** | **Data Destination** | **Purpose** | **Sequence** |
|---|---|---|---|---|---|
| | ▪ Passenger status changed to ‘arrived’ | Vertiport operator | Flight operator | Flight operator is aware of the location of the passenger | 1. Passenger live status updated |
| | ▪ Passenger name<br>▪ Passenger weight<br>▪ Baggage number and weight<br>▪ Passenger flight information (date, time, location (start and end)) | Vertiport operator | Flight operator | Vertiport operator systems need to calculate the payload and centre of gravity to confirm the eVTOL is safe to fly | 1. Total payload calculated<br>2. Confirm maximum take-off weight is not exceeded<br>3. Allocate seats to passengers |

**Table 6-2 – Passenger journey data flow**

# 7. Data protection

The processes described in this report involve the exchange of personal data between a passenger, a flight operator and a vertiport operator. Passenger name, weight, contact details, flight details and, in some cases, biometrics will all be used to confirm identity and support security screening processes with the aim of delivering a seamless travel experience.

As a result, stakeholders will need to consider potential data protection implications. Any personal data must be collected, processed, stored and deleted in accordance with the principles that underpin UK Data Protection legislation, as detailed in section 7.1[41].

In addition to being a legislative requirement, the successful management of personal data can offer many benefits to stakeholders. Compliance will reduce the risk of significant fines and, in demonstrating that they care about personal passenger data, brand and reputation will improve and trust will be established between all involved.

All organisations involved in processing personal data will need to adhere to UK data protection legislation. Rather than provide a comprehensive overview of the legislation, this section highlights key areas for further consideration when managing biometric data.

## 7.1 Principles of UK GDPR

UK GPDR sets out seven key principles that outline the main responsibilities for organisations when it comes to processing personal data.

1. Processing should be lawful, fair and transparent.
2. Personal data shall be collected for specified, explicit and legitimate purposes.
3. Personal data must be adequate, relevant, and limited to what is necessary.
4. Personal data shall be accurate and kept up to date.
5. Personal data shall be kept for no longer than is necessary.
6. Appropriate security measures must be in place to protect the personal data held.
7. Organisations must take accountability for how personal data is managed and demonstrate how they comply with the other principles.

Compliance with the spirit of these principles is a fundamental building block for data protection practice and therefore should be at the forefront of solution design. Some of the practical considerations arising from this need for compliance are explored further in



[41] ICO: The Benefits of Data Protection Laws (Ref A6.1)

the following sections. Definitions and further information on the principles of UK GDPR can be found in Appendix A.6 UK GDPR and data security.

## 7.2 Lawful basis

Prior to processing personal data, a lawful basis must be established as set out under Article 6 of the UK GDPR[42]. This can be one or more of the following:

1. Consent
2. Contract
3. Legal obligation
4. Vital interests
5. Public task
6. Legitimate interest.

In addition to establishing a lawful basis under Article 6, at least one condition under Article 9 and where appropriate additional safeguards under Schedule 1, must also be met prior to processing biometric data[43] – see Table 7-1 – Conditions for process, Article 9 below.

| **Conditions for process, special category data under Article 9** | **Safeguards as per Schedule 1** |
|---|---|
| Explicit consent | No |
| Employment, social security and social protection (if authorised by law) | Yes |
| Vital interests | No |
| Not-for-profit bodies | No |
| Made public by the data subject | No |
| Legal claims or judicial acts | No |
| Reasons of substantial public interest (with a basis in law) | Yes |
| Health or social care (with a basis in law) | Yes |
| Public health (with a basis in law) | Yes |
| Archiving, research and statistics (with a basis in law) | Yes |



[42] ICO: UK GDPR Article 6 – Lawfulness of Processing (Ref A6.2)

[43] ICO: UK GDPR Article 9 – Special Category Data (Ref A6.3)

**Table 7-1 – Conditions for process, Article 9**

Care should be taken when establishing the lawful basis, as altering this once processing has commenced could potentially lead to a breach in the organisation's accountability and transparency requirements. This is particularly important when selecting consent as a lawful basis.

Further analysis is required to identify the most appropriate lawful basis for processing passengers' personal data. Once this has been identified, the outcome must be recorded in the organisation's Record of Processing Activity.

## 7.3 Data protection impact assessments

Whilst it is good practice to conduct Data Protection Impact Assessments (DPIAs) at the start of all major projects, Article 35 of the UK GDPR[44] stipulates that a DPIA must be completed when processing is likely to result in high risk to the rights and freedoms of individuals. As the vertiport passenger journey described in this report is reliant on processing large volumes of biometric data, a DPIA will need to be undertaken and its outcome formally documented. The DPIA provides a mechanism for methodically assessing and documenting potential data protection risks and must:

1. Describe the nature, scope, context and purposes of the processing.
2. Assess necessity, proportionality and compliance measures.
3. Identify and assess risks to individuals.
4. Identify any additional measures to mitigate those risks.

If the DPIA identifies any high risks that cannot be reduced through appropriate mitigation the organisation must consult with the Information Commissioner's Office (ICO) prior to starting to process the data.

## 7.4 Data security

All parties involved in the processing of personal data throughout the vertiport passenger journey have an obligation to ensure appropriate technical and organisational measures are in place to preserve the confidentiality, integrity and availability of the information being processed. These measures may vary from organisation to organisation, and will be dependent on the specific processing activity being undertaken. There are, however, several common controls and measures which stakeholders may wish to consider.



[44] ICO: UK GPDR Article 35 – Data Protection Impact Assessments (Ref A6.4)

1. **International security standards:** Implement a recognised security standard such as ISO/IEC 27001[45], Cyber Essentials[46] or NIST Cyber Security Framework[47].
2. **Encryption**: The use of recognised encryption standards to encrypt data at rest and in transit will help reduce the risk of sensitive information being inappropriately accessed. Any technical solution implemented should be supported by appropriate policies and guidelines for using encryption tools.
3. **Pseudonymisation:** Replace one or more identifiers with pseudonyms, for example replacing names with reference numbers thereby limiting the volume of identifiable information. For this to be successful the identifiers must be kept separate from the main source of data.
4. **Access management:** Access to personal data should be based on the need-to-know principle. This should be enforced with identity and access management policies, procedures and audit capability.
5. **Data recovery:** To ensure access to personal data is maintained, an effective recovery strategy should be implemented and regularly tested. This should include taking regular backups of production data, ensuring backup solutions are segregated from the organisation's network (cloud provider or alternative offline solution), and testing restoration activity to ensure the organisation can recover from unplanned disruptions such as ransomware attacks.
6. **Vulnerability management strategy:** Ensure all operating systems and software are regularly reviewed and updated to the latest version. Where this cannot be performed automatically, implement procedures which detail how and when updates should be applied.
7. **Training and awareness:** Deliver a comprehensive training and awareness programme for all staff on key areas of data protection, such as how to protect personal data, the process for responding to data subject rights' requests, the steps required for managing personal data breaches, and effective records management. Bespoke training should also be delivered for those individuals who operate in specialist roles, such as Data Protection Officers, individuals managing data subject rights' requests, and HR personnel.
8. **Response plans**: It is impossible to eliminate the possibility of a data breach, whether through malicious activity such as a cyber-attack or accidental data leakage. It is therefore essential that organisations have robust plans in place for detecting and responding to data breaches.

## 7.5 Additional considerations

In addition to the above, the following considerations should be understood and actioned to ensure the necessary processes and roles are in place ahead of implementation.

1. **Appointing a Data Protection Officer:** As commercial passenger eVTOL services are dependent on the large-scale processing of biometric data, a Data Protection



[45] ISO/IEC 27001: Information Security Management (Ref A6.5)

[46] NCSC: About Cyber Essentials (Ref A6.6)

[47] NIST: Cybersecurity Framework (Ref A6.7)

Officer will need to be appointed for each organisation involved with the management of personal data.

2. **Rights request:** Consideration will need to be given to how data subject rights' requests will be managed. Under UK GDPR, organisations have an obligation to ensure all rights requests are processed without undue delay, and no later than a calendar month from the point they were received.
3. **Controller or Processor**: The success of commercial passenger eVTOL services is dependent on the collaboration of multiple organisations each with a need to process personal data. It is therefore important that each organisation understands its role as either Controller, Processor or Joint-Controller. Each role has specific obligations under the UK GDPR, so organisations should take time to carefully assess their status.
4. **Restricted transfers:** Under the UK GDPR, personal data cannot be transferred outside the UK unless the third country is covered by the UK adequacy regulations, or the transfer has appropriate safeguards in place such as Binding Corporate Rules or Standard Contractual Clauses. This is particularly important in relation to the integrated multi-modal journey use case covered in Section 8.1.

# 8. Impact of future use cases and regulations

This report has referenced several use cases, within which there are many variations that will support increasing demand and widespread adoption of passenger eVTOL services. These include, but are not limited to, integrated multi-model journeys, scheduled charter services and autonomous flight and vertiport operations.

The requirements of these use cases, as well as those for industry regulations such as passenger security, should be incorporated into system design, to future-proof passenger journey infrastructure and avoid the need to retrofit solutions at significantly increased cost.

## 8.1 Integrated multi-modal journeys

Commercial passenger eVTOL services will likely integrate with other forms of transport to form a seamless door-to-door multi-modal journey from point of origin to destination (see Figure 8-1 – Integrated Multi Modal Journey below). In this scenario, a passenger may be required to confirm their identity before they travel to a vertiport, or upon arrival as they embark on their onward journey. As a result, the systems involved in the pre- and post-vertiport stage of the overall journey will need to integrate with those in the vertiports, and data will need to be exchanged between relevant stakeholders to facilitate a seamless travel experience throughout. If the journey involves international travel, the destination country must have adequate regulations or appropriate safeguards in place as discussed in Section 7.5 Additional considerations.

To enable a seamless door-to-door multi modal journey incorporating other public transportation methods, collaboration between local authorities and transport operators is crucial, as is putting the passenger at the heart of service design.

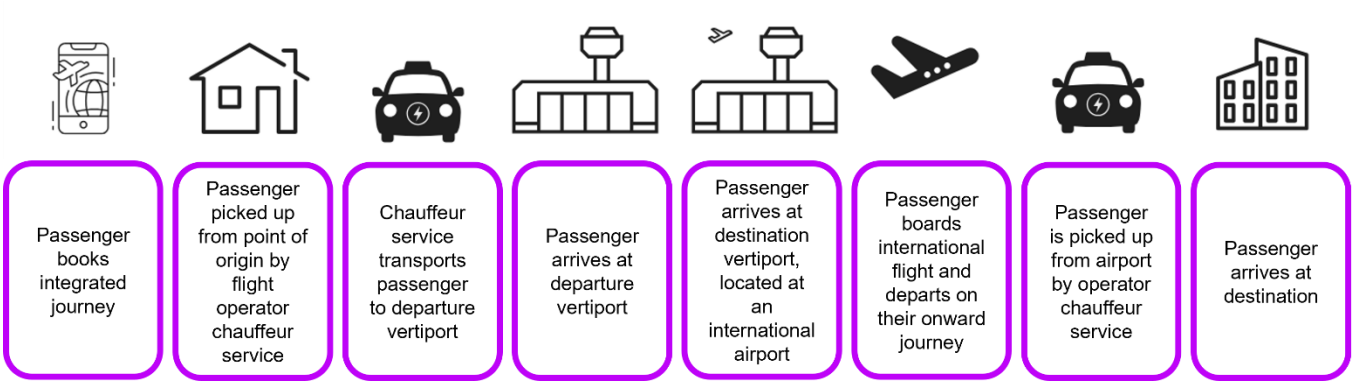


**Figure 8-1 – Integrated Multi Modal Journey**

## 8.2 Autonomous flight and vertiport operations

The initial use cases assume that eVTOL aircraft will be piloted in the short-to-medium term, and that the vertiport will be staffed (albeit supported by automation using technologies such as biometrics) to support both the ‘happy day’ passenger journey described in Section 2 The passenger journey and various possible exceptions described in Section 2.2.

However, longer-term industry ambitions for autonomous flight and vertiport operations will see a shift towards remote management and operations. Exactly how these processes would be managed in an autonomous environment remains to be seen but the exchange of data between stakeholders will need to be efficient and secure, and interoperability of systems designed into systems from day one to support efficient and timely management of passengers.

## 8.3 Impact of security screening regulations

One of the biggest unknowns associated with passenger eVTOL services is the level of security screening requirements. Some form of physical security will be needed in vertiports to mitigate against the threats associated with a new, innovative mode of transport, but to a level that is still unknown and is being explored by the AMEC consortium. It will likely fall somewhere between a low-security regulatory landscape, such as travel by train or bus, and a high-security regulatory landscape, such as international commercial aviation.

The level of security regime will impact the time taken for passengers to travel through the vertiport and, in turn, the time they are required to arrive at the vertiport before departure. Feedback from passengers spoken to by AMEC consortium members suggests that passengers expect a degree of security, though the time expended to conduct security activities should be commensurate with the duration of the journey.

In the future, for passengers travelling on a domestic or international flight as part of an integrated onward journey, additional security information may need to be captured and exchanged as part of airport security checks. Exactly what information will depend on the level of security regime adopted at vertiports and integration with airport processes. This could present an opportunity to complete security screening checks upfront in the passenger journey, reducing the need for security checks later. This would need to be

supported by the exchange of data between vertiport and airport detailing the outcome of passenger security screening[48].

It is important that any solution is designed with open architecture features, to simplify upgrades and the addition of new components as regulation evolves and technology advances.

As this document is concerned with the processing of passenger data, the broader question of security is outside its scope. While we might highlight the relationship between the security regime and the passenger journey, we do not aim to provide an answer.



[48] ACI Europe: Open Architecture for Airport Security Systems (Ref A5.2)

# 9. Conclusion

The commercial viability of passenger eVTOL services is dependent on the speed at which vertiports and flight operators can process and transport passengers to their onward destination. Minimising the time passengers are required to spend inside a vertiport, and hence the overall door-to-door travel time compared to other modes of travel, is critical to success.

Technologies such as biometrics can be implemented throughout the passenger journey to help facilitate a seamless travel experience. Not only will this improve efficiency and passenger experience, but it will improve security, an increasingly important factor as the industry evolves.

To ensure passengers experience minimal disruption, the exchange of data between stakeholders throughout this journey needs to be well-defined and understood by those involved. The main stakeholders – passengers, vertiport operators and flight operators – need to trust one another and be willing to share data to prevent the passenger journey becoming fragmented and hence subject to disruption. These stakeholders should aim to process and store the minimum amount of personal data required to achieve the desired outcome. It should be noted that there is not a single, centralised data repository accessed by all relevant stakeholders; at any given time, different stakeholders will hold their own copies of the same data items.

Flight operators and vertiport operators will be responsible for the secure storage and exchange of passenger data, to facilitate a non-intrusive, hassle-free experience. In processing passenger's personal data, flight operators and vertiport operators will be required to comply with data protection legislation, retaining personally identifiable data only for as long as justifiably permitted. The implications of this should be investigated and understood as soon as possible, to provide stakeholders with ample time to implement the required processes and roles.

It is important that any passenger journey solutions are designed with forthcoming regulations, future use cases and accessibility in mind, to avoid the need to retrofit solutions in an industry likely to see rapid change over the next five to ten years. Incorporating future requirements into solution design will not only save time and money, but also ensure there is little to no disruption to vertiport operations as they adapt.

To date, vertiport passenger journey requirements have been somewhat overlooked as industry efforts have, understandably, focused on aircraft certification and vertiport infrastructure planning. It is, however, important to consider these requirements, to ensure the successful adoption of commercial passenger eVTOL services. The steps outlined in this report form the foundations of the approach that should be undertaken.

# APPENDICES

# Appendix A. Further reading

## A.1 Advanced Air Mobility and general aviation

| Ref | Source | Description and Link |
|---|---|---|
| A1.1 | Levitate Capital | The Future of the Drone Economy |
| A1.2 | Future Travel Experience | How Heathrow uses innovation and automation as a creative leap to a more sustainable future |
| A1.3 | UKRI | Future Flight Vision Roadmap |
| A1.4 | AMEC/Connected Places Catapult | AMEC Social Desirability Report, July 2023 |
| A1.5 | UKRI | Future Flight Challenge – Mini Public Dialogue Report, June 2022 |
| A1.6 | AMEC/AtkinsRéalis | Future Flight Challenge – Cyber Security Strategy, July 2023 |
| A1.7 | Open Access Government | The challenges of data security and queues at airports |

## A.2 Passenger experience

| Ref | Source | Description and Link |
|---|---|---|
| A2.1 | Eurostar | Eurostar Rolls Out 'SmartCheck' Facial Biometric Check-In System |
| A2.2 | Independent | Travellers shocked after airline weighs woman on baggage scale \| The Independent |
| A2.3 | Warner Bros | Tour Accessibility – Warner Bros. Studio Tour London (wbstudiotour.co.uk) |
| A2.4 | BSI | Publicly available specification for wheelchair passports achieves British Standard status \| BSI (bsigroup.com) |
| A2.5 | IATA | Guidance on the Transport of Mobility Aids (iata.org) |
| A2.6 | CAA | Regulation (EC) No 1107/2006 of the European Parliament and of the Council of 5 July 2006 concerning the rights of disabled persons and persons with reduced mobility when travelling by air |
| A2.7 | The Independent | British Airways changes policy to require photo ID for UK domestic flights \| The Independent |

| | | |
|---|---|---|
| A2.8 | Air Accident Investigation Branch | Aircraft Accidents and Serious Incidents: Guidance for Airline Operators (publishing.service.gov.uk) |
| A2.9 | CAA | Aviation safety \| Civil Aviation Authority (caa.co.uk) |
| A2.10 | IATA | Global_Passenger_Survey_2022_Highlights_iata.org.pdf |
| A2.11 | Transport Focus | Transforming rail travel – Feb 2022 |
| A2.12 | Rail Delivery Group | About (raildeliverygroup.com) |
| A2.13 | Rail Delivery Group | Transparency (raildeliverygroup.com) |
| A2.14 | Gov.UK | Guidance on rail passengers' rights and obligations: regulation No 1371/2007 – GOV.UK (www.gov.uk) |
| A2.15 | IATA | IATA – Mission & Vision |

## A.3 Disability strategy and statistics

| Ref | Source | Description and Link |
|---|---|---|
| A3.1 | GOV.UK | Employment of disabled people 2023 – GOV.UK (www.gov.uk) |
| A3.2 | Scope | Accessibility and disability UK statistics – Scope for business |
| A3.3 | Conservatives | Conservative Party Manifesto 2019 (conservatives.com) |
| A3.4 | GOV.UK | National Disability Strategy (publishing.service.gov.uk) |
| A3.5 | GOV.UK | The Inclusive Transport Strategy: achieving equal access for disabled people – GOV.UK (www.gov.uk) |

## A.4 Identity and biometrics

| Ref | Source | Description and Link |
|---|---|---|
| A4.1 | The Biometrics Institute | Types of Biometrics |
| A4.2 | The Biometrics Institute | The Three Laws of Biometrics |
| A4.3 | The Biometrics Institute | Ethical Principles for Biometrics |
| A4.4 | Gov.UK | UK digital identity and attributes trust framework beta version (0.3) |
| A4.5 | Northern Ireland Statistics and Research Agency | Census 2021 update \| Northern Ireland Statistics and Research Agency (nisra.gov.uk) |

| | | |
|---|---|---|
| A4.6 | Office for National Statistics | Passports held by age – Office for National Statistics (ons.gov.uk) |
| A4.7 | Transport Scotland | Motor vehicles, traffic and driving \| Transport Scotland |
| A4.8 | Gov.UK | Driving licence holding and vehicle availability – GOV.UK (www.gov.uk) |

## A.5 Open architecture and interoperability

| Ref | Source | Description and Link |
|---|---|---|
| A5.1 | airport-technology.com | Open Architecture: a new vision for airport security |
| A5.2 | Airports Council International (ACI) Europe | Open Architecture for Airport Security Systems |
| A5.3 | British Computer Society (BCS) | What is interoperability? |
| A5.4 | Passenger Terminal Today | Interoperability, the key to a seamless journey |

## A.6 UK GDPR and data security

| Ref | Source | Description and Link |
|---|---|---|
| A6.1 | Information Commissioner's Office (ICO) | The benefits of data protection laws |
| A6.2 | Information Commissioner's Office (ICO) | UK GPDR Article 6: Lawfulness of Processing |
| A6.3 | Information Commissioner's Office (ICO) | UK GDPR Article 9: Special Category Data |
| A6.4 | Information Commissioner's Office (ICO) | UK GPDR Article 35: Data Protection Impact Assessments |
| A6.5 | International Organization for Standardization (ISO) | ISO/IEC 27001: Information Security Management |
| A6.6 | National Cyber Security Centre (NCSC) | About Cyber Essentials |

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| A6.7 | US National Institute of Standards and Technology (NIST) | Cybersecurity Framework |

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Concept of Operations::
Passenger Data
May 2024