

Digital Think Tank

White Paper

2022

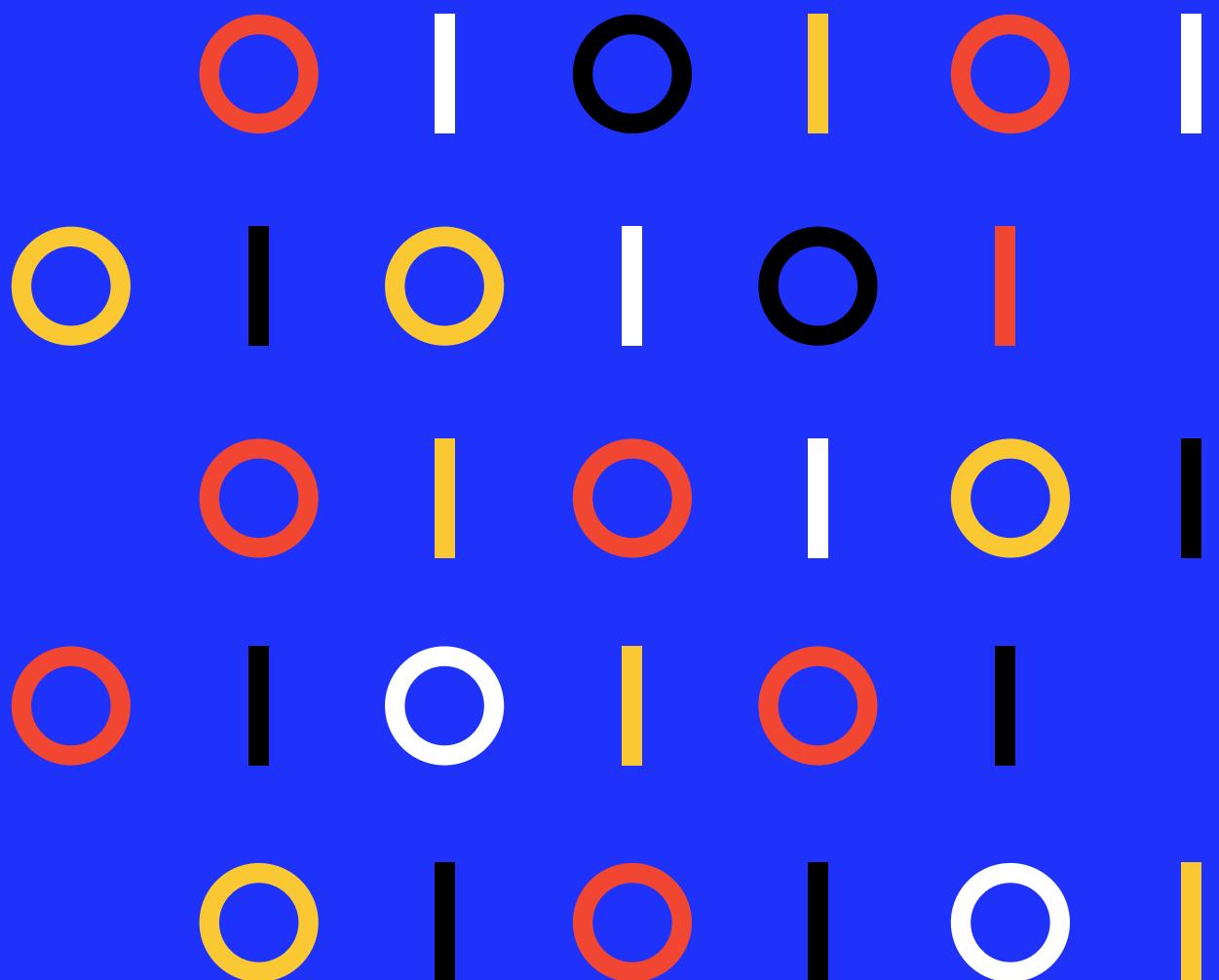


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Foreword

Stephan Copart

Head Digital Transformation, FSDS

Over the past few years, our industry has been facing incredible challenges. The COVID-19 pandemic has put a complete stop to aviation (outside of cargo) for over two years. Today, despite witnessing a true recovery for major domestic markets and with international traffic on the rise, the industry is still facing major challenges with operating costs under immense pressure, increasing jet fuel prices, more cumbersome processes at the airport, and staff shortage. The return of high demand combined with these challenges generated significant disruptions for passengers last summer with many airlines and airports being unable to provide the quality of service expected from passengers. This only confirms that our industry still needs to adapt, and that digital transformation should remain a key priority for our industry.

A digital transformation strategy is a set of integrated technological choices that fundamentally change the way you deliver value to customers and operate internally to create higher profitability for the industry and the stakeholders involved. Under the guidance of its Digital Transformation Advisory Council, IATA has developed the Digital Airline Ambition 2030 that outlines this integrated strategy needed to support digital transformation of the industry. The strategy covers all business dimensions of the airline, articulating the envisioned future state for each of them.

In 2022, IATA also developed a program approach with the vision to enable customer centric digital airlines in control of their product, money, and data, increasing value creation. Endorsed by the Board of Governors at the last IATA AGM, this approach is based on four main pillars: efficient airline retailing based on modern technology; ability to digitally identify partners and customers; customer in control of their data; and seamless end-to-end customer experience including contactless travel.

From a digital strategy perspective, IATA focused its efforts on the commercial and customer experience business areas to support the program and launched a series of initiatives to build future standards and technology enablers to facilitate this transition. Digital Identity, Open API, Contactless Travel or Advanced Data Analytics are part of these initiatives.

In this context of major digital transformation, IATA's role is key. We bring airlines and industry players together to collaborate on delivering a common digital transformation goal.

Whether it concentrates on thorough design thinking to explore and build the long-term future of our industry, or whether it focuses on experimenting new concepts to unlock pinpoints in the way of existing transformation programs, the think tank is a critical building block for the industry to transform itself. It also demonstrates how collaboration can achieve greater and faster results than any individual initiatives, when it comes to transformation at industry level.

This year, the team has covered all the above aspects in their think tank cycle. They focused on demonstrating the value of how the new digital identity framework being currently explored can bring tremendous value to the customer experience. "Trust me, know my needs" tackles how establishing a trust framework within the airline ecosystem and using the latest technology on digital identity and verifiable credentials can improve drastically our customer experience. Extreme Look-to-book ratios can be an impediment to true airline retailing adoption and implementation. Building on previous think tank editions, the team is proposing here a toolbox for airlines to use according to their own individual needs to mitigate and overcome this issue. Finally, the team has also looked at horizon 3 possible transformation. They explored what challenges and opportunities the Metaverse could bring to the aviation industry once passed its nascent stage.

Also, I would like to note that the team also worked on an important theme in sustainability. However, during the exploration of the theme, the IATA team decided that it was best to pause the activity for the time being. This is a normal part of the ideation exercise. While we work on extremely important themes and topics, we also work with internal and external experts that advise us on various challenges and obstacles. They also guide us on the optimal time to work on themes that would enable the industry to react the most positively.

I am looking forward to sharing these ideas across the industry. Digital transformation is also about becoming more agile. Feedback and input from all stakeholders in the industry on these ideas will help us enhance or improve them to enable their implementation through initiatives supporting our ambition to build full customer centric digital airlines!

I would like to thank the airlines, partners and IATA colleagues that took part in this edition of the Digital Think Tank.

Executive Summary

The purpose of this white paper is to articulate the ideas and themes that were brainstormed and further developed throughout the 2022 think tank activity. It includes the background or current situation, with detailed explanations on the team's idea and thoughts. It also includes more info on potential proof of concepts. The intent is to start a conversation and explore these ideas further across the wider aviation community.

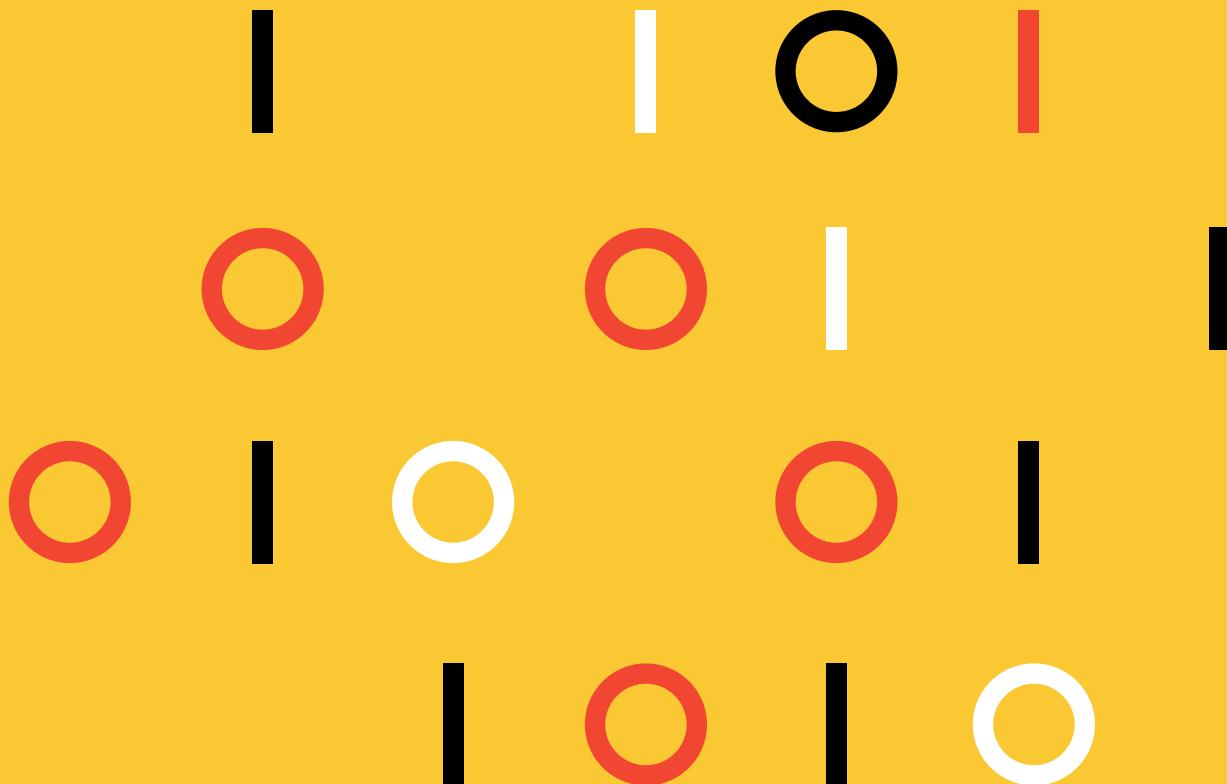
Digital is one of the top priorities for every airline. 2022 marked the second edition of the Digital Think Tank. The team brainstormed potential themes and developed them throughout the year. Unfortunately, one of the themes, focused on sustainability, had to be parked this year because our governance suggested that it was not the optimal timing for this theme. This does happen from time to time, but our role in IATA is to make sure the work is not lost and we will endeavor to pick up where we left off soon.

The team worked on the following ideas that are articulated in this white paper:

1. Trust Me, Know My Needs
2. Addressing Extreme Look-to-Book Ratios

The team also explored an emerging topic:

3. Metaverse



Digital Overview

Background

The Covid pandemic strengthened the need for our industry to accelerate its digital transformation.

At the peak of the pandemic the industry had to face unprecedented challenges like processing massive cancellations and refunds, witnessing its traditional forecasting capability based on historical data falling apart or the scheduling system showing its design limitations just to name a few.

During restart, other challenges arose like adding passenger health checks and contact tracing in the process, with a complete disjointed regulatory framework in this area.

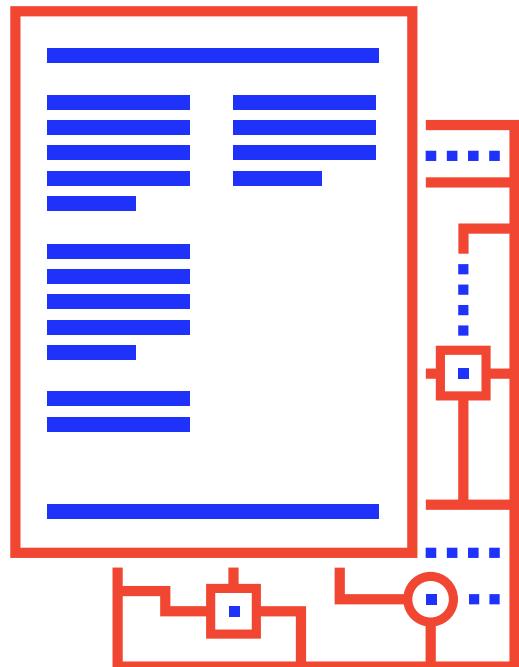
Now that the industry is in a recovery phase with volumes close to 2019 levels for domestic markets and promising growth of international traffic, other challenges add up to the list. More cumbersome passenger processes inherited from the pandemic combined with inadequate airport infrastructure and staff shortage caused the chaotic situations many passengers experienced this summer.

This demonstrates that the industry needs to rethink completely the way it operates and develop a successful digital transformation strategy to achieve this transformation. To date airlines have initiated some transformation but nothing is "fundamentally different". And that's the key for digital transformation. It distinguishes it from digitization, which is what the industry mainly did over the past years. Electronic ticketing, self-service options, online booking, etc., is "just" digitization of existing processes that have not changed and which are still based on legacy technology.

One could argue that this provided digital experiences to customers, the first element of the digital transformation strategy framework. It is however not enough to achieve full digital transformation. The industry has not yet fully engaged into any digital transformation of functions or processes.

Vision and Horizon

IATA members built the Digital Airline Ambition 2030. The digital airline vision furthers the industry ambition for airlines to reach full digital maturity by having a clear digital transformation strategy aiming at transitioning away from legacy processes and technology. The framework illustrated below identifies a proposed end state across all business dimensions of the airline supported by the development of key digital enablers for the industry.



The Digital Airline Ambition

Ambition 2030 — 100% Digital Airlines: The Digital Airline Ambition is articulating the industry vision for airlines to reach full digital maturity by having a clear Digital Transformation Strategy and by reaching the proposed end state for each business dimensions listed below. This reflects the industry aspirational goal of transitioning away from legacy processes and technology.

Planning & Execution	Commercial			Flight & Aircraft Operations	Environment	Back Office
Anticipate Demand Airlines use new data sources and advanced analytics to dynamically anticipate demand and to build predictive models for supply mapping.	Building Offers Airlines dynamically create, price and promote personalized products (incl. 3rd party content) and bundles of products in real time in response to a shopping request and its full context received through any channel. Airlines transition away from static content.	Distribution Channels Airlines seamlessly distribute offers through all chosen channels and transition to orders away from legacy artefacts. (EMDs, PNRs, e-tickets). Distribution of cargo services is fully integrated in the global supply chain and indistinguishable from other modes of transport.	Digital Payment Airlines provide added value to customers, increase customer reach and sales conversion by supporting the consumer's digital payment instruments of choice (B2C) at any touch point. Airlines are in control of the flow of money using more efficient B2B digital payment alternatives.	Flight Planning Accurate AIM and MET information is available to support efficiency and predictability. Airline's flight dispatch operations are digitally driven and optimized to consider operating costs, on-time performance, customer experience and the environmental impact. Airlines, ANSPs, and airports continuously negotiate optimal flight plans from gate to gate supporting efficient and environmentally friendly trajectories.	eAircraft & Maintenance Real time access to aircraft status and components allowing data used in decision-making to improve safety & performance. Digital supply chain is transparent with real-time visibility into location and status of parts/supplies and technical history. All maintenance tasks planned and recorded electronically to ensure compliance with maintenance requirements.	Technology for Environment Airlines and their business partners use digital technologies and advanced analytics to maximize efficiency, decarbonize operations and reduce emissions. Technology and digitalization to record the production, use, claiming, and crediting of SAF and its related lifecycle emissions. CO2 emissions calculations, CO2 reporting and carbon offsetting functionalities are fully integrated in all airline business processes.
Scheduling Scheduling decisions optimized across all functions and KPIs (i.e., revenue, cost, customer & employee experience) Airlines, airports and government authorities collaborate to enable flexible, dynamic schedules continually adjusting to commercial and operational factors.	Disruption Operations Control Centers have real-time access to data needed to effectively manage operational disruption; algorithms determine optimal response to disruption across KPIs.	End-to-end Customer Journey			Digital Tech Impact Airlines opt for resources-conserving IT infrastructures and technologies to support all digitalization programs.	Order to Cash Order to Cash (OtC) processes are automated without the need for legacy records, airline knows the revenue at the time of selling. Payment to airlines are largely made through efficient and seamless forms of payment.
		Customer Identity Airlines, and governments use digital, biometrically enabled identity to accurately identify customers and provide seamless service and enhance travel safety & security. Customers have control over personal data and visibility how their data is used incl identity, travel authorization, health information, other credentials.	Engage & Experience Airlines seamlessly deliver end to end travel experience and provide same information on travel status through all channels. Customers are empowered to manage travel and disruption through all digital channels, including indirect channels and full contactless airport process.	Cargo Flow Airlines and customers have visibility into real-time cargo location and state across the end-to-end supply chain via a 'digital twin'. Algorithms automatically identify and resolve cargo issues.	Baggage Airlines, airports, ground handlers and customers have visibility into real time bag location enabling a seamless flow across the network. Algorithms automatically resolve baggage issues like automated re-routing.	Procure to Pay Procure to Pay (PtP) process is fully automated from delivery monitoring to payment. All airline supplier contracts are automated (no invoices, no separate reconciliation, settlement triggered by goods receipt).
		Ground Operations				

Data & Technology			
Digital Identity Airlines have implemented identity management frameworks allowing for unique digital identification of all resources.	Open Ecosystem Airlines have fully optimized, real-time big data infrastructure, built on leading technologies. Comprehensive innovation program providing open but controlled access to data by 3rd parties (Open API).	AI & Advanced Analytics AI & Advanced Analytics serves as the foundation of airline decision-making and provides competitive advantage in core functions.	Cybersecurity Airlines' cyber-security capabilities are on par with digital leaders, effectively safeguarding key digital assets and proactively managing and mitigating cyber-security risks.

Digital Transformation Strategy & Organization		
Digital Transformation Strategy Enabled by a firm understanding of technology trends and their disruptive impact on the airline industry, the airline has a clear vision of how digital will support the airline's overall strategy, deliver business value and provide competitive advantage.	Digital Talent Airline is among the top companies (across industries) in terms of attracting, onboarding and retaining digital talent. The airline's training and upskilling programs enable one of the most digitally skilled workforces in aviation.	Agility Agile ways of working deployed across the airline, including outside of digital products. Teams work autonomously with a clear customer/end-user focus.

While the Digital Airline Ambition covers every business domain of the airline, the Board of Governors asked IATA to prioritize transformation enabling customer centric digital airlines in control of their product, money, and data, increasing value creation and being more resilient to future shocks.

Digital Think Tank

Vision

The vision is to imagine the future digital airline.

Scope

The digital airline vision encompasses digitalization across the entire journey. The scope of the 2022 Digital Think Tank was therefore wide, however, it was framed by themes provided and supported by the IATA Digital Transformation Advisory Council (DTAC). The themes were brainstormed and the ideas that resulted are further elaborated in this document.

Members

The members of the Digital Think Tank are largely digital experts in various focus areas and specializations who are deeply driven by innovation. The team is a combination of IATA airlines, strategic partners, and IATA subject matter experts. Although the team includes members with various backgrounds, every member has a shared motivation to participate in this activity with an industry mindset.

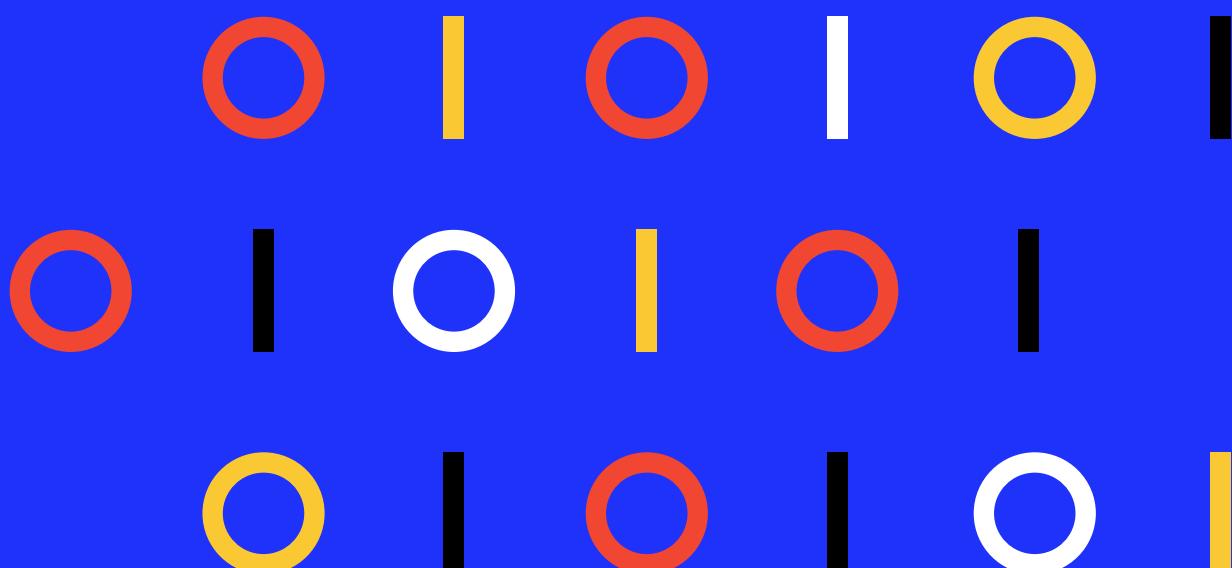
Structure

The think tank is structured to meet face-to-face, four times a year. Although, travel has remained complicated this year and most of the meetings have been hybrid, the team has reiterated the need to focus on face-to-face meetings going forward. It has been tried and tested and this type of brainstorming activity is much more successful in a face-to-face only environment.

The activity did start later than usual this year, but the team has managed to deliver on the themes.

Output

The output for the 2022 is this industry White Paper and demos/PoCs to be presented at the World Passenger Symposium. The aim is to turn these ideas into IATA projects that can in turn lead to industry standards and mass adoption. Also, the aim is to speed up the process of industry buy-in and implementation.



2022 New Ideas

Trust Me, Know My Needs

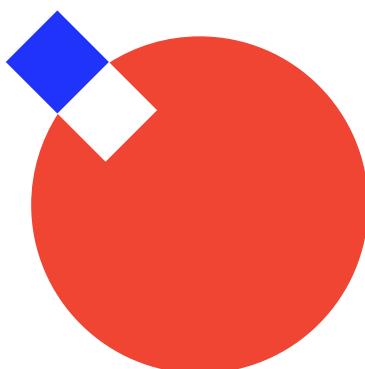
Vision

IATA is highlighting the need to develop digital identity enablers for all parties involved in travel chain. That obviously starts with the customer. As a customer, I should be in control of my data and if I choose, I can identify who I am and what I need or like. Our digital identity program of work is looking at the same principles and technology around verifiable credentials, whether we address final customers, or all parties involved in the chain.

One day in the future, all of us are likely to rely on our digital identity credentials.

In the context of travel, the customer will have their needs met throughout their journey, thanks to this envisioned process of providing easily verifiable credentials. The customer (or delegated authority, such as a parent or caregiver) will store these credentials within their digital wallet, which proves and unlocks entitlement to a specific service and/or set of offerings.

The trust framework in place ensures that credentials belonging to the customer making the claim are authentic and issued from a trusted party and have not been tampered with. A solid trust framework across global boundaries also enables interoperability and scalability: the same credential(s) can be used by and easily recognized by different airlines and service providers in variety of different use cases.



Vision Description

Project Trust Me, Know My Needs is an extension of the work completed over the course of three years, as part of IATA's [three previous Think Tanks](#).

- Starting in 2019, "Truly Me" imagined a connected travel ecosystem with smart objects stored in digital wallets, which allowed a customer to share information selectively with service providers. This concept places the customer at the center of all things and removes the reliance on amassing data for inferring what the customer wants.
- In 2020, "Customer as the Reference" proposed using recently published standards on verifiable credentials and decentralized identifiers (DIDs) to enable customers to selectively reveal their travel information and preferences in a privacy-preserving manner.
- And lastly in 2021, "Customer First" envisaged a truly customer-centric journey of a traveler where the customer – enabled by technology – can enjoy maximum benefit in their travel and retail experience with minimal effort.

Fast forward to 2035, and we can imagine a world where all digital activities will be 100% secure and we don't have to worry about trust. The use of privacy preserving communications using DIDs will be ubiquitous and verifiable credentials will have replaced many forms of Know-Your-Customer (KYC).

This year, encouraged by the evolution of this technology, the 2022 IATA Digital Think Tank presents a proof of concept (PoC) demonstrating how this can benefit both airlines and their customers alike.

In the future, the airline customer experience will encompass a broad use of decentralized identifiers and verifiable credentials for a vast range of claims for service. The customer (or delegated authority) can store the credentials that prove their entitlement to a service in their digital wallet and within open trust frameworks.

Building off the previous white papers, the Project Trust Me, Know My Needs explored ways to enhance the experience of "Passengers with Disabilities" (PWD), a growing area, with varying unique needs – many of which carry significant liability for the members and align to regulatory requirements. In current practice, requesting special service assistance may, in some cases, require the sharing of sensitive personal and medical data, and as such, customers deserve to have their assistance service needs met in a manner which better protects both the protection of personal information and mostly the passengers get the service they request. Imagine if the customer was able, at each point of their journey, to have their special accommodation requirements met through providing verifiable credentials – without having to provide information for future flights taken by the same passenger, particularly when the passenger has a permanent disability that requires accommodation on all flights going forward. This white paper presents how technology can positively transform the travel experience for these customers and bring efficiency to airlines and operational processes.

The PoC demonstrates the feasibility of using a digital identity wallet to store verifiable credentials that are easy to request, easy to store, and easy to present, enabling proof of entitlement to a service, in a privacy-secure and customer-centric way. The solution ensures scalability, interoperability, and trust. The wallet will serve well to ensure a seamless and dignified, end-to-end customer experience that supports special accommodation needs, marking a significant departure from today's inquisitive and fragmented customer experience. Also, illegal conversations will be eliminated, as the verifiable credentials are reviewed and processed away from the customer touchpoints during travel, and away from inquisitive (or potentially intrusive) front-line staff.

People who have difficulties to navigate busy airports, i.e., who do not have a physical disability that requires the use of a wheelchair in their day-to-day life but have certain limitations which impact their ability to walk long distances, or stand in queues for long periods, are often anxious in the navigation of an airport. Waiting times throughout the airport journey – at check-in, bag drop, security checkpoint, and boarding – can exceed individuals' ability to manage without the use of an assistance service at the airport. Additionally, as airports grow in size, so do the distances between curb side and departure gates, or between gates in the case of connecting flights. In non-aviation use cases, people with reduced mobility often possess an authority-issued credential, such as a mobility parking permit, that caters to this need in civic, social and commercial interactions. This permit allows for priority use of designated parking close to entrances of public buildings to ensure equal access to services for those who would struggle otherwise.

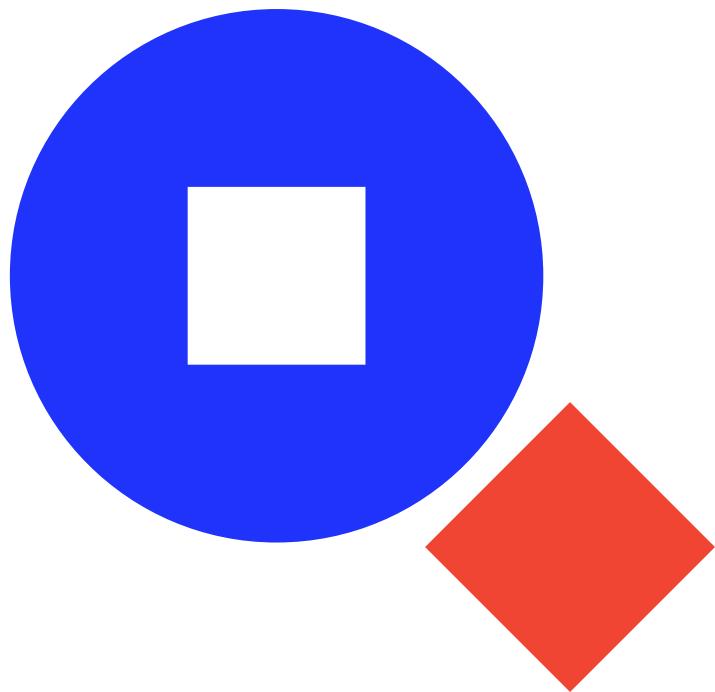
Imagine if a proof of such a permit was able to be issued as a verifiable credential to allow airline customers to seamlessly seek this special service in their airport journey, and have priority for such a service, as it does in other areas of their day-to-day life? This is what is envisaged with this PoC.

Using decentralized identifiers is by its nature scalable because one can establish as many connections as one wishes to, and that is the beauty of the technology. The industry requires an interoperable and open ecosystem that includes numerous global stakeholders. Trust registries are needed so that the credentials that have been issued can be verified. No recommendation on who should be in charge is made in this paper, but such registries could be provided by governments or by robust entities that act as proxies, such as IATA.

This technology can be expanded to include any services a customer consumes throughout their travels and be applied to a broad range of claims for services beyond the use case presented in the PoC.

For example:

- Handle unaccompanied minors outside of the regulated age bracket, or any assisted passenger.
- Check and approve special licenses to carry weapons or other specific goods in hold, including preparation for formalities at destination.
- Request for allergen-free or medical meals.
- Other credentials that the passenger could apply for, which would provide information directly to airlines and eliminate the need to repeat lengthy administrative processes every time they book a flight. For example, airlines require dimensions and data about a customer's foldable electric wheelchair – and a credential could store size, weight, and battery details of the item and any other information that is necessary to the airline and the handler for the safe loading and securing of the aid in the cargo compartment of the aircraft.



Scalability, Interoperability and Trust

While the scope of the PoC has been articulated for a very specific use case, we can take a more holistic view of the scalability and powerful reach that can be achieved in due course. Specifically, we view the scalability of this PoC not only just in terms of frequency of a specific use case, but in four other distinct areas:

- 1.** Workforce and process automation – with automated processes in place to verify customer credentials, the need for cumbersome and 24/7 manual processing decreases. Within the trust framework, if credentials can be verified automatically, processing time decreases significantly which in turn reduces labor requirements and operational costs and, when automation is involved within this framework, accuracy and consistency in verification should increase and thereby mitigate the risk of human error. Some airlines realized this during the pandemic through the use of machine learning to quickly automate verification of COVID-19 vaccination records and test results.
- 2.** Reciprocity – as airlines expand their interline and partnerships in various formats, they are also aligning processes to provide mutual benefit for their shared customers. With IATA standards already in place for activities like interline baggage handling and recovery, there is an existing foundation of trust amongst airlines. As a natural evolution of this PoC, airlines can verify credentials for each other when multiple carriers are involved, and thereby reduce the need for a customer to undergo this process several times.
- 3.** Scalability to other services – using verifiable credentials beyond the specified use case in this PoC, airlines can prioritize and/or validate eligibility for their customers to receive services, benefits, or other entitlements. The intent of this idea is not to replace the current manual processes involved in enabling these services but rather to provide the same seamless and digital customer services to people with disabilities as are offered to all customers. In the future framework of offers and orders, we assume a solution will exist to transmit the booking of a wheelchair to various operators (airlines and airports services). This PoC would enable differentiation between "verified wheelchair orders" vs. "wheelchair order". This allows for an automated and secure fulfill/deliver of a service for a customer, which provides a more efficient delivery that safeguards privacy for the customer. In a situation where resources (assets) are limited at a specific location, this will enable airlines to prioritize the order in which they fulfill requests.

- 4.** When a customer asserts a personalized need, the service to be provided may in certain cases, overlap with ancillary services which are normally chargeable for a fee. With verifiable credentials in place, airlines have a clear view on which customers may secure additional items or services the person is entitled to. Airlines and operators can then adapt the local regulations and competition landscape¹.

Scalability also supports multiple non-aviation situations: for example, waiting lines in major amusement parks where some accommodations are made for customers with disabilities which others may see as a benefit and be tempted to misuse. The same situation holds true elsewhere, such as sporting events, concerts, or other large-venue performances.

We retain that this PoC is only the start of a future projects. The combination of a solid trust framework will enable the future of air travel to be more efficient, while at the same time preserve the integrity of services and entitlements that might be misused in recent years at the expense of those who have real disabilities or need support of special assistance trained and certified dogs vs others that use the system for personal advantage. The passenger with their digital identity wallet could then store and use these credentials across the travel experience including intermodal transport, rental cars, hotels, tour bookings and beyond.

Trust

- Determining 'who' would be a trusted issuing party is out-of-scope for the PoC.
- For this PoC it can be assumed that "all IATA member airlines are trusted issuers of this credential".

¹ In compliance with the IATA competition guidance this document does not further elaborate on more specific cases.

Current Situation

The wheelchair assistance at the airport is often associated to the IATA special service request (SSR) code "WCHR" and is often offered and fulfilled on a first-come, first-serve basis. The process for requesting and receiving this service differs between airports, airlines, airports/airlines providers and systems.

Air carriers and airports lament a misuse of this service. Over the years, some customers tend to exploit the line-cutting privileges given to people who request airport wheelchairs assistance, for which – as a rule- no proof of a disability is required. While this is a complimentary service offered to customers, it constitutes an onerous cost absorbed by airline members.

More recently, in the context of the recruitment and rostering challenges after the COVID crises, one of the key issues at airports has been the increase in requests for wheelchair assistance and the potential misuse of assistance services by some passengers. This issue has deeply concerned IATA members and disabled passengers alike for many years and we continuously urge regulators to encourage airports and assistance services providers to look at more sustainable solutions to support those passengers who are not disabled but may need to use a wheelchair as a way to navigate potentially busy and confusing airports. Regulations in most jurisdictions prohibit airlines to ask for more details in regard to the genuine need for wheelchair assistance at the airport, and due to the sensitive nature of disability information disclosure, there is added complexity in managing and safeguarding information to determine a priority for access to the service.

Customer Experience Requesting Additional Assistance Today

- Customers with disabilities often must put in place a complete set of preparations and may require assistance at different points during travel, a long time in advance: airport and city transfers, medical assistance, safety assistant, specific hotels etc. Travel is seldom a commodity for these customers and customers who receive the best service travel more.
- Passengers with disability should enjoy a seamless experience as it is provided to all customers. Customers can be asked about their additional assistance requirements many times, at each touchpoint requiring a customer to share the same data many times, and often personal and medical data. This is increasingly challenging when the disability is not visible. Customers want to be reassured as soon as possible and all along the journey that everything is prepared for a serene and safe travel.

- Personalization is key: The level of assistance cannot be assumed. Customers with similar conditions may need very different levels of assistance. This is particularly true for less visible disabilities.
- In some specific medical cases there needs to be interaction or detailed medical certification (e.g., as IATA MEDIF) released by the family doctor and an airline accredited doctor to determine that the person is safe to fly.

Airline Challenges Today in Fulfilling Requests

- Airlines want to provide same access to all customers; this is the right thing to do.
- When a medical certification or a proof for fit to fly is requested for medical cases, airlines propose a range of standardized set of assistance services that are provided under the form of international IATA standard: For example, WCHC, WCHS² or WCHR³? Oxygen on seat or portable set? Extra leg room or stretcher? Full time assistance or only guidance at connection points?
- Airlines have to manage inconsistent and confusing regulatory requirements. For example, airlines must prepare 48 hours in advance vs. no discrimination in questions asked to customer (in the USA).
- Revenue integrity: airlines already face cases of misuse or inconsistent application of assistance requests. For examples: requests for extra leg room seat for passengers who are not immobilized, or extra seats fee exemption that is only valid in certain jurisdictions and for very specific cases.
- Airlines need to identify customers with assistance needs in the systems to provide prompt service e.g., for disruption handling (i.e., accommodation, rerouting).



² WCHS – passenger who cannot ascend and descend steps, where the wheelchair is required to/from the aircraft and the passenger must be carried up/down the steps but is able to make their way to/from their seat.

³ WCHR – Passenger can ascend and descend steps and move in the aircraft cabin but requires a wheelchair for distance to/from aircraft.

A Typical Customer with Disabilities Travel Experience

Passengers with disabilities can finalize their travel booking online, but often the assistance service request is asked later in the process when passengers are strongly recommended or requested to notify the airline through helpline/assistance number in advance of the travel (e.g., at least 48 hours in the EU).

In the cases of specific medical conditions, the family doctor will contact the airline medical advisor to ensure the person is safe to fly and receives the proper level of assistance.

At the airline, specific trained staff can study the possible answers and add remarks in all the relevant booking segments (PNRs for legacy systems). All this process is by verbal communication and manual intervention. Most of the time customers have no written proof that their request was taken into account.

Carriers and travel agents use SSR codes available to add services into an electronic profile for passengers known as an IATA Passenger Name Record (PNR). Although travel processes are regulated by global standards and protocols some airlines and travel agents may use additional codes not included in the IATA Resolution 700. These additional codes are not standardized and therefore may not be recognized and processed by other airlines' and ticket agents' systems. This can result in inconsistencies in the service provided by different airlines systems.

For passengers traveling with their own battery powered mobility aids, specific safety procedures, in accordance with international safety regulations on dangerous goods some additional information are requested. Some airlines may need this information much in advance to alert the handlers and prepare the aid to be safely loaded and secured in cargo compartment of the aircraft.

Unfortunately, in case of multi-carrier or international travel, information on the safety and handling procedures may not be properly transmitted and the passenger could be requested to provide the mobility aid information at the transit point.

And when travel occurs, in case there is a disruption, a shortage of staff or high-volume demand at the airport, there is no consistent approach for the airport operator or the airline to correctly prioritize which customer needs the most urgent assistance.

In summary, today's challenge for airlines is how to be customer-centric and unlock the full potential of digital identity technology for customers in need of an "additional assistance requirement".

Proof of Concept (PoC)

Scope

For this PoC, the customer seeking a special assistive service (i.e., WCHR⁴) uses verifiable credentials (VC) to demonstrate to the airline, in a seamless and automated way, their legitimate request for needing wheelchair assistance. The customer may then reuse the credential for another booking on a different airline as it has been already verified within the trust framework.

The customer with reduced mobility⁵ needs assistance getting through the airport and therefore opts to advise the airline that this on-airport assistance (e.g., wheelchair service) is a necessity to ensure priority is given in the provision of this service, not just for this journey but for any subsequent journey with any carrier.

The PoC focuses on the time of booking, as airlines retain that this is the key moment where the airline can check and order the special services the customer needs. Note: The way the services are later fulfilled or checked during the journey is not covered in this PoC. However, this PoC does demonstrate how the verifiable credential, once stored in the customer's digital wallet, can be used to claim this service for any subsequent air travel.

Scenario

A European Union based customer has a trusted digital identity wallet and an authority issued disability card. The customer is booking a point-to-point flight and needs to advise the airline that they require a special service in the form of wheelchair assistance up to the ramp in the airport.

The customer is presented with an option to have a VC issued from the airline directly to their digital wallet that they can use to ensure priority allocation for this service for this and future flights with this and any other participating airline. After some simple steps, the airline issues to the digital wallet a new VC: "Validation of WCHR service". The customer can now use this credential to seamlessly claim the service for this and any subsequent flight and also to ensure they are a priority for the WCHR service.

The solution, proposed in this PoC will enable airlines to address these points, adding personalized PWD services, better managing demand levels while protecting the privacy and dignity of the customer, under full compliancy of fast-evolving local requirements.

The trust framework in place ensures the credentials belong to the customer who requires the assistance, are issued from an appropriate issuer and have not been tampered with. The technology enables the airline to ensure whatever standardized service request remark is present in its system at any step of the customer journey.

At any point of the journey (the PoC will demonstrate at booking) with any issuer, be it an airline, travel agent, alliance, or aggregator, the customer is requested to provide the documentation that states it is a necessity to have the assistance (e.g., authorized 3rd parties such as an authority issued disability or mobility card, or medivac evaluation to determine the need, insurer, or public health certificate). The customer presents a credential issued by a trusted entity to the airline and the airline determines authenticity and issues a VC to the customers wallet, binding the identity to prove the credential is owned by the customer.

In the future, as an expansion of the PoC, we envision dynamic lists of trusted issuers can be established and updated.

Customer Action — First Booking

The customer is booking a flight with Airline A directly on the Airline A website.

The customer needs to advise the airline that they require a special assistive service for navigating the airport but can make their way to the aircraft seating, the SSR code allocated to their booking will be WCHR.

- The customer is presented with an option to use an existing digital identity and to have a VC issued from the airline into their digital wallet that they can use to ensure priority allocation for this service for this and future flights with this and any other participating airline. (Prompt for the customer) to opt for a digital identity wallet of their choice.
- The customer opts to use their existing digital Identity wallet. The airline website presents a QR code for the customer to scan.
- The customer scans the QR code and provides consent to connect. (Note: the airline portal generates the QR code: it can use standard algorithm or request external APIs from a third-party company).
- The customer accesses the digital identity through wallet authentication protocols.
- The customer is invited to scan their EU disability card (Note: this example is an EU-based customer with an EU disability card, but the same applies to any authority issued mobility/disability card or certificate).
- The card is verified and ensures the customer's details are matched to the details in the digital identity wallet.
- If satisfied that the card is genuine and issued to this passenger, the airline issues a validation of WCHR service VC to the digital wallet.

⁴ IATA resolution 700 defines WCHR (Wheelchair—R for Ramp) as such: passenger can ascend/descend steps and make own way to/from cabin seat but requires wheelchair for distance to/from aircraft, i.e., across ramp, finger dock or to mobile lounge as applicable.

⁵ The definition of passengers with reduced mobility is understood to be any person whose mobility is reduced due to physical disability (locomotory or sensory) intellectual impairment, age, illness or any other cause of disability and who needs some degree of special accommodation or assistance over and above that provided to other passengers.

- The customer confirms the final consent of the sharing from the wallet to the airline.
 - Proof of identity and
 - Validation of service credential (zero knowledge proof or selective disclosure (e.g., validity)) with airline.
- The customer exits wallet and returns to booking.
- The customer continues through the booking as per normal.

The Airline

- Receives proof as a VC.
- Verifies that it belongs to the customer presenting it.
- Verifies that it was issued by a trusted issuer.
- Verifies that it has not been tampered with and is still valid.
- Verifies that the SSR code WCHR is the relevant service code to support the customer's request and needs.

For services with several options to fulfil the need, the airline will follow-up with complementary exchanges to precise the relevant solution, Identify Assistive Services Provided to the Passenger according to the disability type⁶. This is one benefit of the credential: it contains the relevant code that is specific to the need of the passenger and according to the assistance that is requested for their type of disability. Airlines can therefore collect related information for the purpose of managing the special services requests without retaining any sensitive personal data and with clear and informed customer consent.

So, contrary to the current situation, this follow-up will not have to be repeated with other bookings once the credential is validated.

The storage in a digital wallet of passengers' information assumes that passengers who require a certain service will be provided this accommodation every time they fly on the airline. However, accommodation is not necessarily required for every trip, such as for temporary disabilities (e.g., broken leg). Airlines are not qualified to determine or validate whether a disability is temporary or permanent, or the duration of a disability.

The airline completes the booking so that the service is recognized at every touch point with a high priority.

Customer Action — Second Booking

The customer now has a trusted digital identity and trusted validation of the assistance service e.g., WCHR (from the first booking) and is now booking a flight with airline B directly on the airline B website (Note: this could be booked via a mobile app for deep link, however, in the PoC the customer is booking on the website).

The customer is managing their booking and needs to book a special service in the form of wheelchair to ramp in the airport.

- The customer is given an option to use an existing digital identity in order to share the validation of the WCHR service VC.
- The customer consents to use their digital identity.
- The airline website presents a QR code for the customer to scan. The customer is presented with a request for credentials from the airline.
- The customer consents and authenticates to share credentials with the airline.
- The customer returns to the booking.

Recommendations

The future model of interaction with the passenger is leveraging on a set of emerging technologies.

A central position is taken by the model of VCs. The passenger's device will be enabled to become the central point to store personal data, from which different credentials could be shared depending on the situation.

For example:

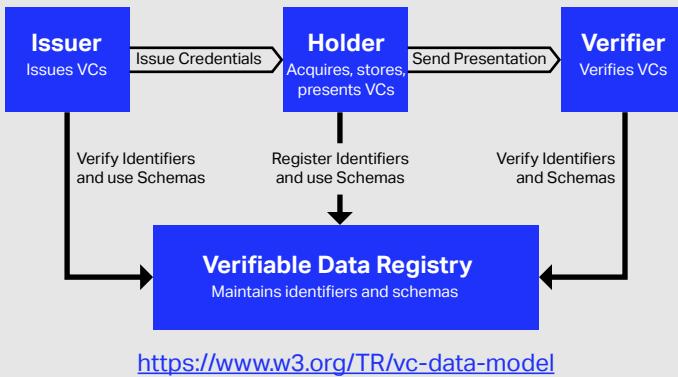
- I could share my full health credentials with a government which requires to know the details while making sure the airline only sees the fact that I hold the credential without showing any details.
- I could selectively share information that airlines would require in order to prepare for a smooth handling at the departure and arrival airport (including airport of connecting flight). Information such as wheelchair type, use of own wheelchair until check-in or boarding gate.

⁶ Resolution 700 requests airlines to apply three specific SSR Codes identifying the assistance for passengers who need a wheelchair or who have a certain type of mobility disability are:

- WCHR (1) (Wheelchair – R for Ramp) – passenger can ascend/descend steps and make own way to/from cabin seat.
- But requires wheelchair for distance to/from aircraft, i.e. across ramp, finger dock or to mobile lounge as applicable.
- When service animal is accompanying passenger, specify the type of animal in free text of SSR Item.
- WCHS (1) (Wheelchair – S for Steps) – passenger cannot ascend/descend steps, but is able to make own way.
- To/from cabin seat; requires wheelchair for distance to/from aircraft or mobile lounge and must be carried up/down.
- Steps. When service animal is accompanying passenger, specify the type of animal in free text of SSR Item.
- WCHC (1) (Wheelchair – C for Cabin Seat) – passenger completely immobile; requires wheelchair to/from.
- Aircraft/mobile lounge and must be carried up/down steps and to/from cabin seat. When service animal is accompanying passenger, specify the type of animal in free text of SSR Item.

Decentralized Identity Implementation

Privacy preserving trusted interaction are achieved in the digital world by leveraging decentralized identifiers (DIDs) and VCs. The World Wide Web Consortium (W3C) has developed [standards for digital decentralized identifiers](#) and [verifiable credentials](#). The airline industry, through the IATA Digital Transformation Advisory Council (DTAC) and Architecture and Technology Strategy Board (ATSB), has set the direction to leverage these standards for the development of standards for the industry.



There are multiple implementation options compliant with the previously mentioned W3C standard. The two main types of implementations are the one relying on Open ID protocols and the one leveraging the Hyperledger ecosystem. It is therefore necessary to look at the implementation stack with more granularity to identify all the components part of the ecosystem and work on their interoperability. [The Trust Over IP](#) give a framework to identify all the layers of the ecosystem and compare them.

Key standards used by the solutions of the Open ID family:

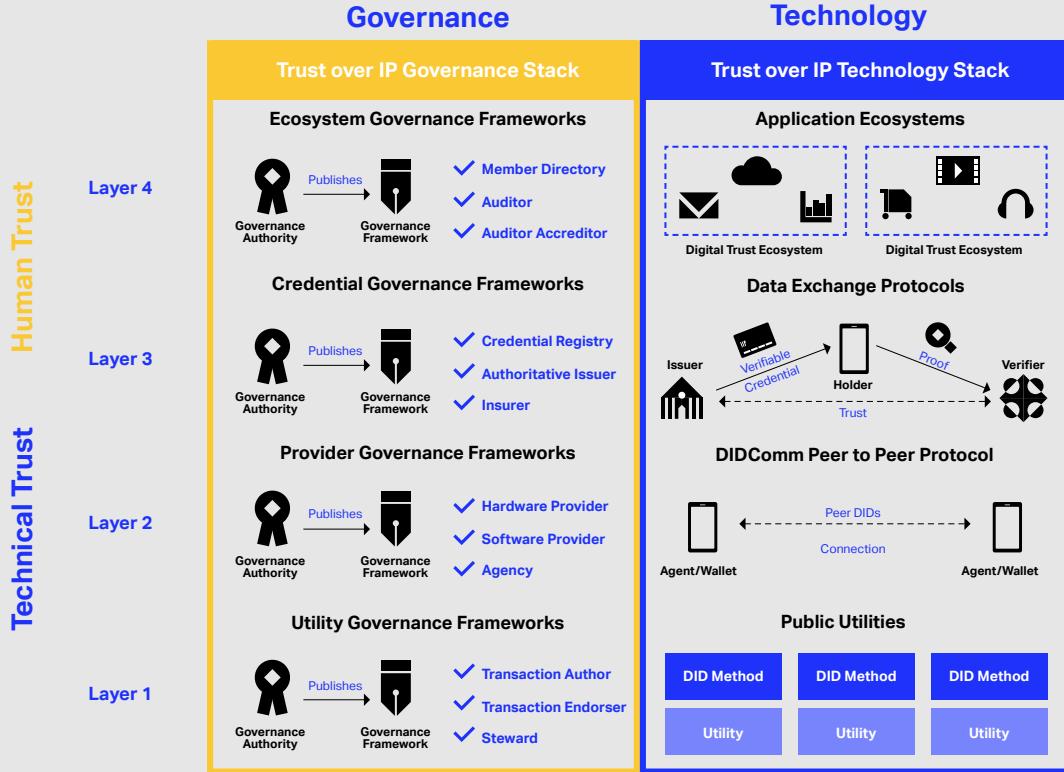
- https://openid.net/specs/openid-connect-self-issued-v2-1_0.html
- https://openid.net/specs/openid-connect-4-verifiable-credential-issuance-1_0-05.html
- https://openid.net/specs/openid-4-verifiable-presentations-1_0.html

Key standards and protocol used by the solutions of the Hyperledger family:

- Hyperledger Aries
- Hyper ledger Ursula
- <https://identity.foundation/didcomm-messaging/spec>

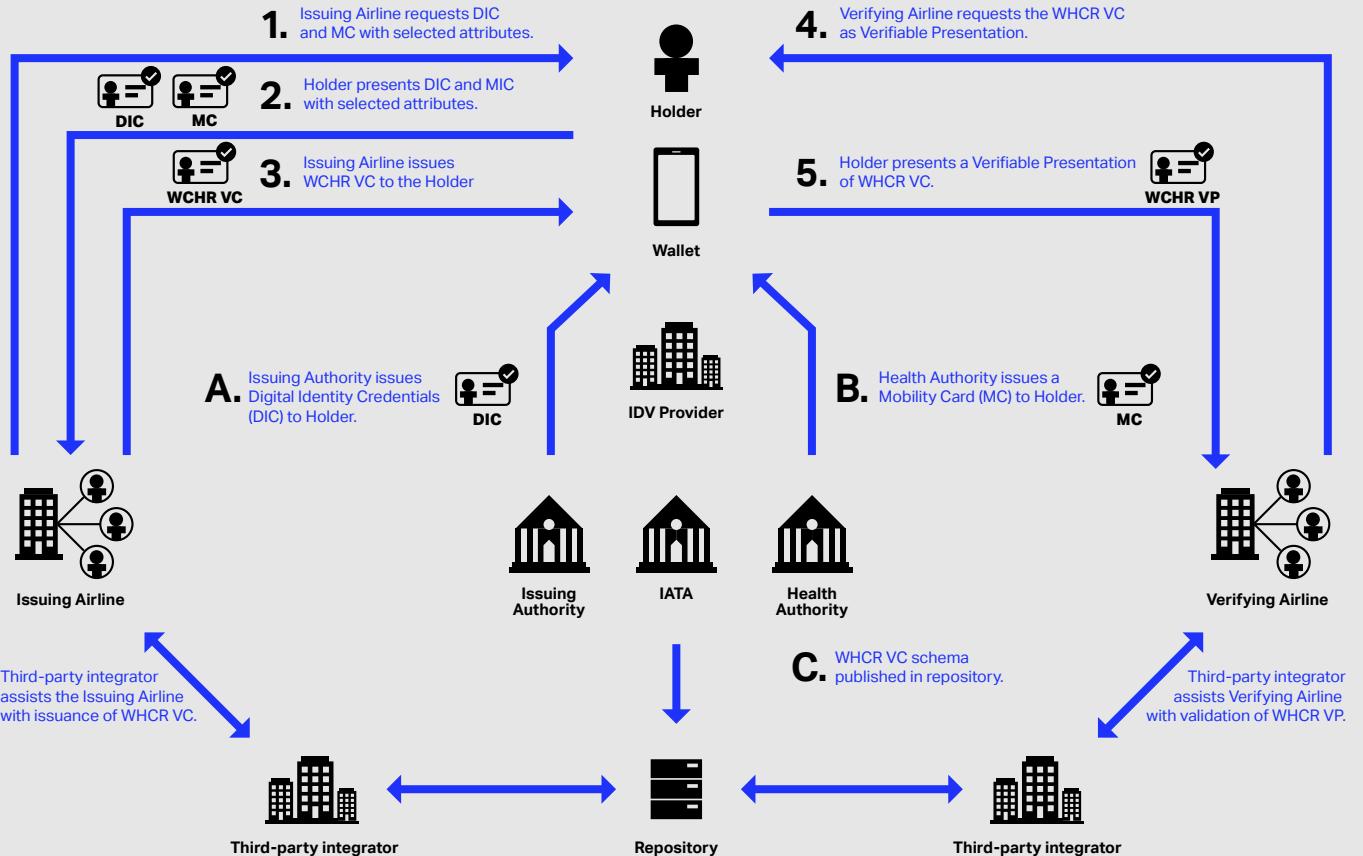
This PoC was developed using freely available and open tools that leverage an Hyperledger solution based on the Sovrin DID method and Decentralized Identifiers Communication protocols.

- Issuance of credentials such as shown in the diagram below allows the traveler and the issuing airline to perform this task only once, after which the verifiable credential can be used for all future trips provided that the credential remains valid.
- The verifiable credentials can be issued by using one of the protocols (DIDComm protocol) for credentials issuance or OpenID Connect for Verifiable Credentials Issuance.



Proof of Concept High Level Design — Workflow

In the picture below, a high-level design workflow for the PoC illustrates the issuance and presentation of credentials. The prerequisites and process steps are explained in the subsections below.



Roles of the Entities

The roles of the entities are the following:

- **User:** Users of Digital Identity (DI) wallets are defined as natural or legal persons who use the DI wallet to receive, store, and share digital credentials and particular attributes about the user, necessary to prove their identity or to verify their identity attributes.
- **DI Wallet:** The DI wallet is an application on a mobile device, which gives the user sole control over their personal digital identity credentials, VCs, and any other personal attributes within their DI wallet. The DI wallet will also allow the user's sole control over secret cryptographic material (e.g., private keys) needed for proofs, signatures, or authentication. A DI wallet mobile application can be provided by an airline or a trusted third-party provider.
- **Issuing Authority:** The issuing authority is accredited by the national state for issuing Machine Readable Travel Documents (MTRDs) – this includes ePassports, Passports, some Identity Cards, and Digital Travel Credentials (DTC) that are compliant with ICAO 9303 – the MTRD standard from International Civil Aviation Organization. For example, the ICAO DTC can be issued by a Passport Authority based on the user's eMRD as identification document.
- **Health Authority:** The Health Authority is accredited by the national state or municipality for issuing health documentation to the User, such as vaccination certificates or Mobility Cards that allow disabled people the rights to travel with certain assistance, park in reserved parking places, or access special services. This could also be an Insurer or private medical provider.
- **Issuing Airline:** The Issuing Airline issues additional credentials, like a Special Service Request (SSR) Verifiable Credential (VC) on customer request or consent. In the PoC scenario, the SSR is for using a wheelchair (WCHR) at the airport.
- **Verifying Airline:** The Verifying Airline requires proof of the credential. In the PoC use case, the Verifying Airline is checking the proof of the credentials during booking management. However, this could be during web or self-service check in or at any point in the passenger journey. The User will use the DI Wallet with the travel credentials to prove identity and credentials to the Verifying Airline.

- **Repositories:** The Repositories hold the public information about credentials. There are different types of repositories, such as: ICAO's Public Key Directory (PKD) for eMRTDs; DTC; DID repositories with DID documents; and the EU Gateway for Digital Covid Certificates (DCC) and Certificate Revocation Lists. In the PoC scenario, the Repository is storing IATA's WHCR VC scheme.
- **Third-party Integrators:** One type of third-party integrator assists the Issuing Airline with the issuance of the WHCR VCs – this process includes verification of the Holder's identification documents (DTC and Mobility Card) and issuance of the WHCR VC in accordance with the schema that has been published to a repository by IATA. The other type of third-party integrator assists the Verifying Airline with the verification of Holder's WHCR VC Verifiable Presentation – this process includes verification, against IATA's scheme in the Repository, of both the Verifiable Presentation's proof and the WHCR VC.
- **Identity Verification (IDV) provider:** The identity verification provider performs the necessary steps for remote identification of the user. The remote identification process can be performed either through video identification or auto identification where the user shows the physical identification document, such as an eMTRD (ePassport), which is matched to the user's face or other biometrics. More information on remote identity proofing is available in this ENISA report. This approach is consistent with IATA One ID program and that of the previous Digital Think Tanks.

Prerequisites

The prerequisites for the WHCR VC issuance and presentment are described in the subsections below. The prerequisites are labelled with letters instead of numbers to be clearly differentiated from timing perspective.

Prerequisite A: Issuance of Digital Identity Credential (DIC)

The Digital Identity Credential (DIC) is issued to the user and stored in the user's wallet (step A). In the PoC use case, the DTC-eMRTD bound is issued as Digital Identity Credential in the EU to the customer. An IDV process can be performed for remote identification of the user. The DTC's private key is stored in the mobile device's Secure Element under the user's sole control, meaning that only the user can unlock the private key with a PIN-code or their biometrics. The DTC is derived from an electronic Machine-Readable Travel Document (eMTRD). It is an exact representation of the eMRTD (ePassport), that includes the holder's facial image, biographical data, and security features.

Prerequisite B: Issuance of Mobility Card (MC)

The Mobility Card (MC) is issued in the EU to the user and stored in the user's wallet (step B). An IDV process can be performed for remote identification of the user. The Mobility Card's private key is stored in the mobile device's Secure Element under the user's sole control, meaning that only the user can unlock the private key with a PIN-code or their biometrics. The Mobility Card allows a disabled user the right to special services when travelling. In this scenario, the Mobility Card is issued as a W3C Verifiable Credentials format, which is associated with a W3C Decentralized Identifier (DID) document. The Mobility Card is issued by the national Health Authority, insurer or by an airline where the airline has systems and mechanisms in place to comply with privacy regimes the airline will be subject according to the data that is given extra protection because of its sensitive nature (e.g., health data)⁷.

Prerequisite C: Publish the WHCR VC Schema

IATA publishes the WHCR VC schema to the Repository. The WHCR VC schema describes the syntax of the WHCR VC and will be used when the Issuing Airline issues the WHCR VC and when the Verifying Airline verifies the Verifiable Presentation (VP) of the WHCR VC.

⁷ IATA policy position on the collection and storage of data information from passengers related to a request for a service.

Process Steps

Step 1: Issuing Airline Requests DIC and MC

When users book a flight online, they can select the Special Service Request for a WCHR service, which allows the user to use a wheelchair from arrival at the airport until boarding the plane. The Issuing Airline will then request the user to present their Digital Identity Credential (DIC) and the Mobility Card (MC). If applicable, the Issuing Airline can ask for selective attributes of the DIC and MC with respect to the user's privacy.

Step 2: User Presents DIC and MC

The user gives their consent to release the requested attributes of its DIC and MC. Then the user's wallet creates a Verifiable Presentation (VP) based on the selected attributes of the DIC and MC Verifiable Credentials and signs the VP with a proof.

Step 3: The Issuing Airline Issues WCHR VC

The Issuing Airline invokes the Third-party Integrator for issuing the WCHR VC. As part of this process, the Third-party Integrator verifies the Holder's VP with the DTC and Mobility Card. When the user is properly authenticated, the Issuing Airline issues the WCHR Verifiable Credential (VC) to the user – in practice this is likely to occur after the customer has been issued their ticket. The WCHR VC issuance is done by the airline website with the Third-Party Integrator in the backend. The WCHR VC is a long-lived credential, not only intended for this trip but re-usable for future trips with any other airline which accepts verifiable Digital Identity Credentials. The WCHR VC should be issued with a validity that matches the validity of the source Mobility Card. In this scenario, the WCHR VC is issued as a W3C Verifiable Credential. The WCHR VC private key is stored in the mobile device's Secure Element under the user's sole control, meaning that only the user can unlock the private key with PIN-code or biometrics.

Step 4: Verifying airline requests the WCHR VC

The Verifying Airline requests the user to present its WCHR VC in a Verifiable Presentation. The Relying Party in this POC is any airline during the booking management by the customer, and likely prior to completing the check in. In other use cases, with other verifiable credentials, could be at any point in the customer journey, such as self-service check in, lounge access, boarding gate, or transit. The Verifying Airline invokes the Third-Party Integrator, which will assist with the verification process of the Verifiable Presentation.

Step 5: User Presents a Verifiable Presentation of WCHR VC

At this step, the user is authenticated to the Verifying Airline by presenting a Verifiable Presentation of the WCHR VC. As part of the user authentication process, the Third-party Integrator needs to verify the user's credentials. The Third-party Integrator can verify the format of the WCHR VC by checking it against the schema published by IATA in a repository. The proofs of the verifiable presentation and credentials can be verified by downloading the root certificate and revocation information from the verifiable data registry, and then using the downloaded assets for verifying the proof signatures.

Trust

- Determining 'who' would be a trusted issuing party is out of scope for the POC.
- For the POC, it can be assumed that "all IATA member airlines are trusted issuers of this WCHR credential".

Benefits

Introduction offers the following key benefits:

Customer

- Protection of their sensitive personal health information.
- Extend existing seamlessness in home country to possibly the whole world – arrive at airport and straight to assistance.
- Gives customer an acknowledge of what is exactly to be expected.
- Removes need to repeatedly prove entitlement.
- Removes need to repeatedly provide airlines with information needed for handling.
- Reassurance in a potentially stressful situation.
- Enable advance remote check in.

Airline

- Manage demand on assistance and correct allocation of limited-quantity assets (e.g., wheelchairs).
- Efficient processing. Automation can extend coverage 24/7.
- Monitoring GDPR regulation and processes on a single platform for ancillary preferences.
- Decision to grant the entitlement not based on individual decisions by airline staff.
- Minimize fraud and ensuing revenue leakage from ancillary products and services which may be provided free of charge as a result of a specific special service request.
- Loyalty.
- Reduce liability (on the assumption that the credential can be verified).
 - The first and foremost benefit is the customer-centricity.
 - Customer-centric approach also allows airlines to proactively manage.
 - Last but least, this approach is an opportunity for customers and airlines alike to unlock further benefits. For example, the same principles can be used by travelers to share.

Next Steps

The 2022 Digital Think Tank Project Trust Me, Know My Needs recommends that IATA and/or its Member Airlines:

- Develop standards for the personal needs of customers as verifiable credentials to enable digitalization and the one-time issuance of a verifiable credential in the customers digital wallet that are re-usable, interoperable, and trusted across airlines.
- Prioritize use cases which are today's most difficult and in biggest volumes from Airlines and Customer point of view.
- The use of VC in the daily life will come quick. Define how this concept can be applied in the development of Offers and Orders.
- Study more in detail other touchpoints: rebook, check-in, boarding, onboard, etc.
- Study more in details the "unhappy flows".
- Enable a Trust Framework for the use of verifiable credentials in the aviation industry through maintenance of an open verifiable data registry that stores identifiers, schemas, certificates, revocations, and issuer public keys for trusted issuers of credentials.
- Development of trust environment (list of entities) through the established governance by the IATA Passenger Standards Conference to determine the details of the Trust Framework.
- Establish protocols for auditing and authorizing trusted entities to ensure compliance with all agreed-upon principles for this concept.

2022 New Ideas

Addressing Extreme Look-to-Book Ratios

Vision

IATA's "unlocking value creation by putting the customer first" program suggests that, based on current trends, some airlines and their partners will see a world of 100% Offers and Orders by 2030. This means that full capabilities, based on global open standards and modular architecture need to be ready and available for any airline that wishes to embark on this journey.

Today, large volumes of shopping requests from travel sellers reach airlines. As NDC adoption progresses, airlines profitability may be impacted due to extreme look-to-book ratios. In addition, some use cases at inspiration phase may not be answered efficiently with current standards, thus exacerbating the look-to-book issue and limiting the innovation potential (notably on the seller side).

The objective of this Think Tank paper is to provide a portfolio of approaches to enable airlines to address extreme look-to-book ratios:

- API monitoring and subsequent techniques to manage traffic.
- Offer repositories.
- A variety of additions to and evolutions of the standards and documentation for specific shopping use cases.

There is no silver bullet – each tool described in this paper may be relevant to some airlines only and/or be limited to specific use cases. Similarly, each tool will have its own trade-offs that airlines need to accept while moving forward with their implementation.

A better managed look-to-book ratio will ensure the sustainability of airline retailing. It should be noted that IATA does not support or recommend any option in particular. It is up to each airline to develop their own strategy in this area.

Current Situation

Driven by competition, channels fragmentation as well as customer behavior – tending to search simultaneously over multiple channels in a quest for the best offer, we observe a trend of increase of shopping requests. This directly impacts airlines as, by design, each NDC request must reach them.

This situation led to the introduction, in the 2019 IATA AIR Think Tank whitepaper, of Project Robot 1.0; this project explored an offer repository concept that would be part of the airline systems: once generated, offers could be stored and reused while still valid. The aim was to reduce the number of generated offers, which is the main cost component in answering a shopping request.

Project Robot 1.0 projected look-to-books reaching 10'000:1 or worse, when some NDC Offer Management Systems might have been designed with 300:1 in mind. With NDC steady adoption growth, initial projections remain accurate, and the need to better manage look-to-book ratios is confirmed. This year's whitepaper provides a portfolio of approaches to address extreme look-to-book ratios.

First, while decreasing the unit cost (through an Offer Repository on the airline side, for instance) is helpful, traffic reaching the airline remains the same and can still be a bottleneck.

Second, travel sellers report that some use cases widely adopted today (and new ones, as they are constantly innovating to match evolving consumer behavior and expectations) may not be directly supported through existing NDC interfaces. This means that, for use cases such as calendar search for example, sellers may need to make a substantial number of individual calls to the airlines, only adding to the look-to-book issue.

Do Nothing Scenario

In the absence of industry-wide responses, we expect the general look-to-book issue to persist at best, but more likely it will keep worsening, while workarounds can have an adverse effect on airline retailing.

Unmitigated, massive automatic shopping calls (e.g., from metasearch) may seriously weigh on the sustainability of airline retailing. As NDC adoption progresses, some use cases currently inefficiently supported will have more and more impact on airlines. A typical example is calendar shopping for one month: around 450 AirShoppingRQ to obtain offers for any possible outbound and inbound dates permutations (i.e. pairs of dates over 30 days). The feasibility and cost of managing such shopping queries lie on the airlines' side.

Sellers will also continue to employ caching methods, maybe to a greater degree, to be able to reuse offers previously generated by the airlines in a similar context (assuming content, price, availability, and terms & conditions are still exact). While this can reduce the stress on airline systems, it is at a cost of accuracy and bookability, which in turn can impact the end-customer experience and lead to dissatisfaction.

No Silver Bullet — Toolbox Approach Instead

For the 2022 cohort, the Think Tank group explored possible evolutions of Project Robot 1.0, as well as other approaches to address extreme look-to-book ratios. Each tool may only be applicable to particular use cases and/or may come with trade-offs. Individual airlines may view these trade-offs in different manners.

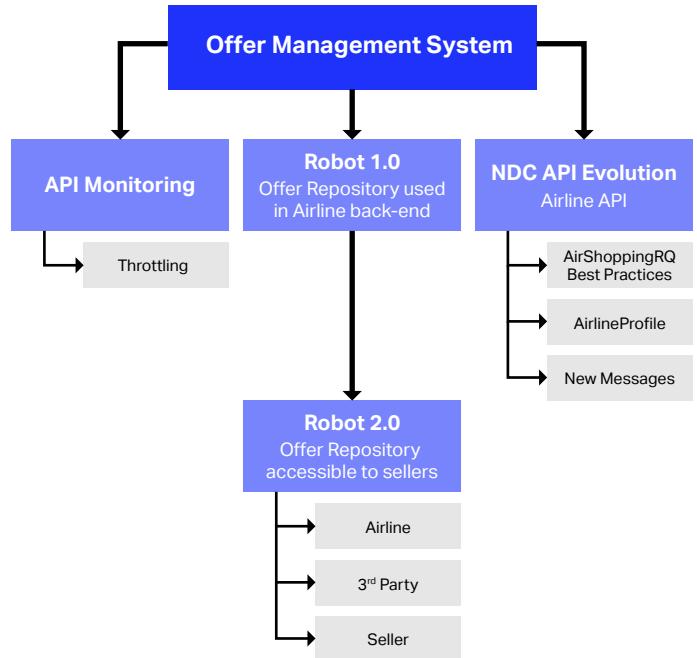
NDC has a set of overarching principles, for example:

- **Control:** The airline controls offer creation, deciding which offers are presented, etc.
- **Visibility:** The airline receives all shopping requests and responds with appropriate offers.

These principles are fundamental to NDC and guide all design decisions. However, for inspirational use cases, an airline will have to consider trade-offs to ensure a scalable approach; in other words, creating a scalable architecture will require trade-offs among competing/conflicting principles.

An important observation was made first. Traffic intensive activities are restricted to specific requests, mainly happening at the beginning of the "conversion funnel": they are characterized by a low intent to book. Such traffic does not require a large amount of offers to be displayed. In some cases, fully structured offers might not even be necessary (e.g., a "starting from..." price might suffice). Current NDC messages are not efficient for this kind of requests. On the other hand, they are well suited to travelers progressing in their exploration and whose intent to book increases.

Particular segments of the demand side – e.g., Travel Management Companies (TMCs) - exhibit high intent to book and thus are not facing look-to-book issues. This section lists and succinctly describes the tools that airlines can choose to use in specific contexts where trade-offs might be necessary to manage the early shopping stage. The following figure shows components airlines can decide to develop, as well as their dependencies. They are explained in the next paragraphs.



A general point before examining each tool in turn – The success/failure of each tool mentioned below will be dependent on the willingness of airlines to implement the specific tool and also on the willingness of sellers to adopt this specific tool.

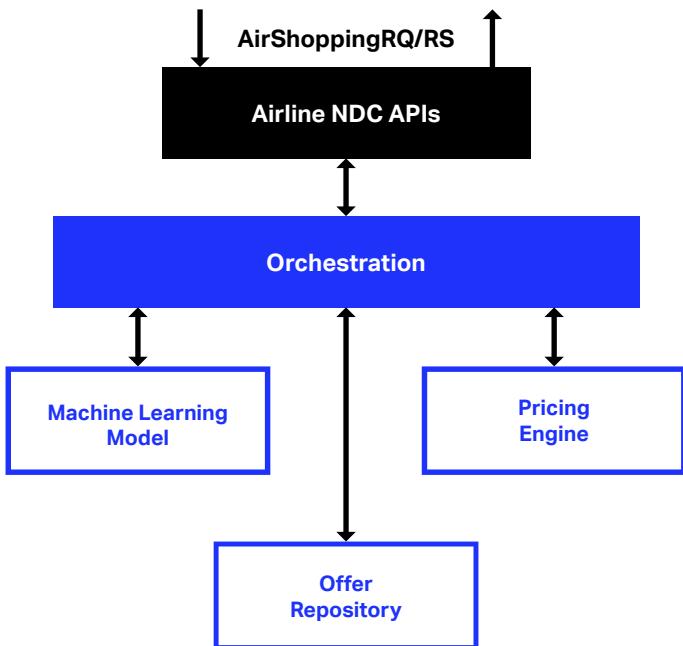
API Monitoring

The first approach is simply API monitoring. Through identification of API users and traffic monitoring, airlines can directly reduce the number of calls reaching them, either through throttling (reduction of calls rate) or through techniques designed to discourage an unreasonable use of the API. This method directly ensures the sustainability of the platform.

Robot 1.0

In the airline backend, a tool to reduce the cost of answering shopping queries is Robot 1.0, as introduced by the 2019 AIR Think Tank. In summary, for each offer generated, the airline decides how long the offer remains valid. This time limit is optimized by using a machine learning model. Offers are kept in an Offer Repository on the airline side ("Offer Store" in the 2019 White Paper). These offers can be directly reused by the airline to answer shopping queries, as long as the time limits are valid.

This tool is a long-term solution to the look-to-book problem. Even though airlines will still have to cope with direct traffic coming to their systems, this solution ensures that airlines retain full control of offers and full visibility of shopping requests.



Robot 1.0: Offer Repository within the airline system

Robot 2.0 — Offer Repository

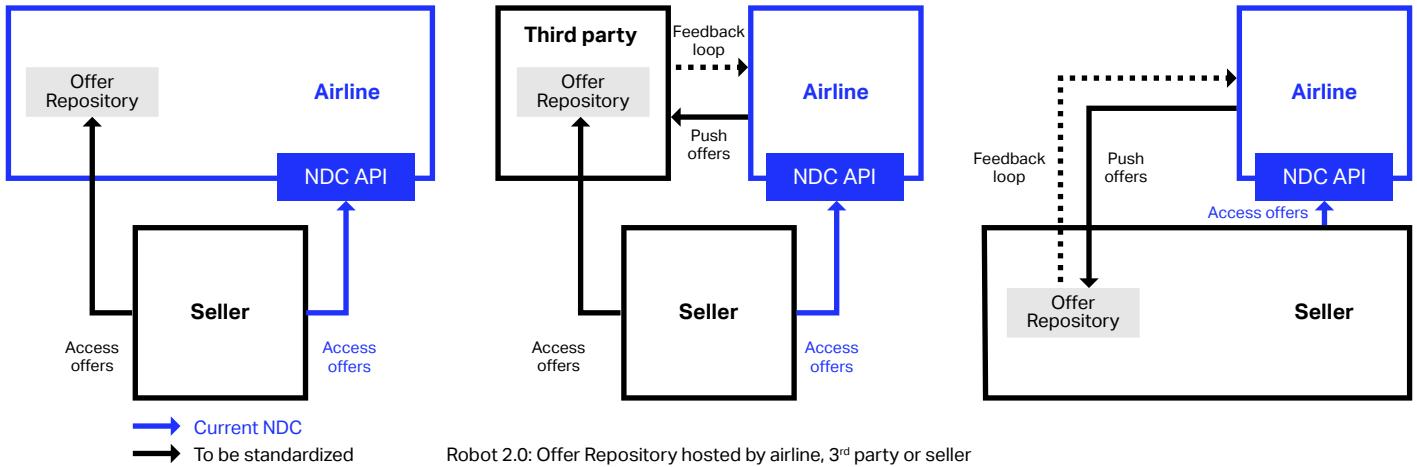
Project Robot 2.0 exposes the Offer Repository concept (first explored by the Think Tank in 2019 with Project Robot 1.0) directly to travel sellers.

An offer repository can still be within the airline IT landscape and be exposed directly to travel sellers; offer repositories could also be operated by 3rd parties and accessible by multiple sellers; finally, an individual seller may decide to host its own offer repository. In all three cases, similar update mechanisms will be used: offer repositories will only be populated with offers created and pushed by airlines. Offers expiry will also be determined by airlines, and not a 3rd party. In addition, in the case a repository is hosted outside of the airline's environment, a feedback loop should be added, which serves the airline to keep a limited track of the shopping front-end of the funnel.

Once an offer repository capability is defined and instances are deployed, sellers will be able to develop innovative inspirational use cases.

It is expected for airlines to lack visibility and traceability on the requests coming to the Offer repository as the feedback loop will be limited to what the offer repository operator/seller will want to share with the airlines. The feedback loop will represent a portion of the information that airlines would have if they were addressing this traffic directly. In other words, airlines will need to trust sellers to share market data with them as sellers/operators will define the rhythm of the feedback loop. This rhythm could represent an opportunity for individual operators which may decide to provide airlines with full access to raw shopping data/full visibility and see this feature as a key differentiator for their offer repository. This approach brings an important trade-off for offer control. Airlines are still the unique source of offer creation. However, they are not controlling which offers are presented to particular customers. Some airlines may be comfortable with this trade-off for these particular extreme cases (i.e., Inspirational use-cases only).

Others may not.



Robot 2.0: Offer Repository hosted by airline, 3rd party or seller

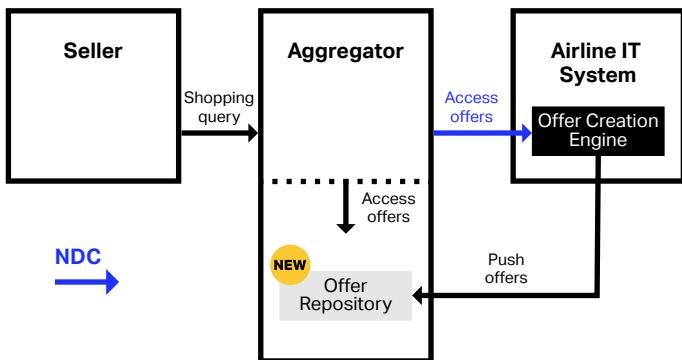
Another trade-off to be looked at is the bookability of the offers exposed in the repository. Each offer has its own time limit, set by the airline. The airline needs to monitor and manage this parameter to ensure bookability remains high. The airline also needs to ensure that it refreshes offers, distributed across the various repositories, so that bookability remains high, this will come with a significant investment.

In any scenario, a link with the traditional NDC shopping process needs to be facilitated, enabling further personalization of the offers for customers; cross-sell and upsell opportunities for airlines.

This approach is only applicable to inspirational use cases. Queries with high intent to book, or personalized ones, should be made through regular AirShoppingRQ calls.

The Offer repository is meant to be a short-term solution for a problem the industry is facing today. Airlines will have to trade-off most of their offer control to reduce the inspiration traffic that will otherwise reach their system directly. Also, as offer creation becomes more and more personalized and dynamic, the value of the Offer repository will be reduced.

To test and validate this Robot 2.0/Offer Repository concept, a prototype has been built between Trip.com, Cathay Pacific, and Amadeus. The structure of this prototype is outlined in the following figure.



Architecture of PoC focusing only on Robot 2.0 & its Offer Repository, stored either on the Airline or the Seller side (prototype use case).

Outcome of the Prototype

In this prototype, NDC offers are pushed from Cathay Pacific (CX) to the Offer Repository, hosted by Amadeus and integrated to the Amadeus Travel Platform Flight Search process. Trip.com is the seller using the Amadeus Flight Search process.

The objective of the prototype is to validate an end-to-end shopping to ordering flow:

- **Shopping**

When receiving a shopping query from Trip.com, the Amadeus Flight Search process decides to retrieve CX content from the Offer Repository instead of calling the NDC AirShopping API to the CX IT system. This content is handled the same way as if coming from NDC endpoint. If relevant to Trip.com, this content from the Offer Repository is flagged as such and sent, among other airlines trip proposals, to the seller.

- **Pricing**

A Trip.com customer selects one of those proposals coming from the Offer Repository. The details of the selected proposal are sent, via the Amadeus Travel Platform, to the CX IT system via the NDC OfferPrice API (AirShoppingRQ bypassed in PoC set-up only). The CX IT system can decide to create an NDC offer from those details, along with potential upsell offers, and return it in the NDC OfferPrice response.

- Any downstream step is following normal NDC flow following that OfferPrice response

Several KPIs have been defined to assess the impact of the prototype. On the seller side, impacts on the shopping traffic, on the shopping response time and the price accuracy between the shopping and pricing steps will be measured. On the airline side, impacts on the shopping traffic, on the number of NDC orders and the corresponding look-to-book ratio will be monitored.

At this stage, the technical validation of the end-to-end flow has been achieved. Functional tests are ongoing targeting a scope limited to 5 markets and 12 city pairs and showing an obviously faster (by a factor of 10) response time at shopping time on Trip.com side. In this early phase, the call to the Offer Repository is systematic and not conditioned to either funnel context or intent to book. An existing offline precomputation of CX content has been used to feed the Offer Repository. Next, this prototype will explore how, when to trigger the call to the Offer Repository based on funnel context, and will also explore ways to implement a feedback loop to give airlines visibility on the Offer Repository activity.

NDC API Evolution

The other tools come from an evolution of the NDC API itself. While these tools can be implemented without Robot 1.0 in place, they may not reduce the stress on the airlines' Offer Management System by themselves. As the cost of high look-to-book ratios mainly comes from offer generation, it could be considered that Robot 1.0 is a reasonable prerequisite to efficiently support specific use cases.

AirShoppingRQ/RS is, in theory, capable of supporting numerous use cases. It can be the case that support for many of these use cases is not implemented by specific NDC APIs. With more official best practices for AirShoppingRQ/RS, complex inspirational queries could be answered with a single AirShoppingRQ/RS transaction, as opposed to the large numbers of individual calls required today. For instance, a calendar-based view of prices for a month would require 450 AirShoppingRQ messages (per airline), each for a specific date pair. While using AirShopping in this method can achieve the desired outcome of building a calendar-based view, it forces airlines to spend CPU cycles calculating offers where the only desired outcome to build a calendar-based view was to generate "from prices".

Another tool, with a similar approach to the previous one, is to design new NDC messages targeted at specific complex use cases of the early shopping stages. Through the usual standardization process, these messages could make shopping more efficient. With such specific messages, airline systems are positioned to generate content in an efficient manner while at the same time understanding the context in which requests are being made. Having better context will allow airlines to further enhance and build relevant and more personalized offers in their shopping funnel in the same way that OfferPrice allows more personalization than AirShopping. This approach comes with its own trade-offs, e.g., time to market of new messages. The general point of willingness to implement/adopt (by airlines/sellers) will re-occur for each new message. New messages or new uses of AirShopping have no impact on the rest of current NDC flows. Once the early shopping phase has passed, more targeted AirShopping calls are used as usual, and all subsequent processes (booking, servicing, etc.) are unchanged.

Finally, a promising, but yet under-utilized tool, is AirlineProfile. This capability enables airlines to describe what kind of shopping queries they wish to receive from sellers: if available and honored, it can directly result in the stopping of completely irrelevant shopping requests. The Shop-Order Standards Board has recently discussed the necessity to revisit AirlineProfile, so as to make it more widely adopted.

NDC API Evolution will bring a long-term solution and will ensure that the principles of NDC are respected while supporting innovative inspirational use cases. Airlines will have to find the right balance between the traffic reduction and the Offer computation in real time.

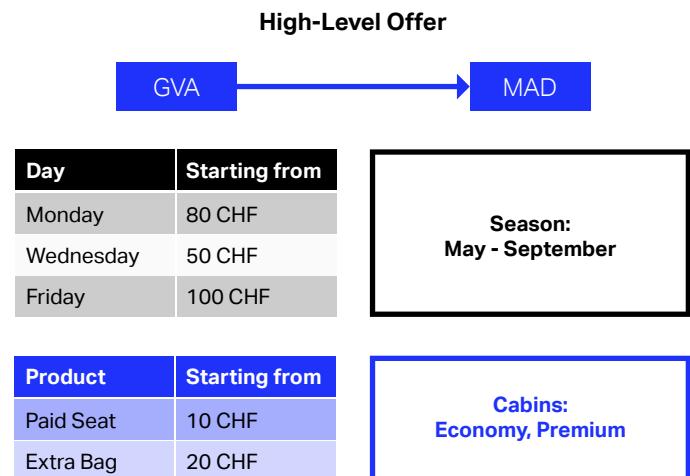
Examples of Use Cases

Typical use cases that have high look-to-book ratios are affinity, inspirational, and calendar shopping. They require significant processing on the airline-side.

In such cases, the useful information is not necessarily in full-fledged offers, which is why there is the potential to optimize these shopping queries. From the seller side, the requirement is to be able to provide an overview (e.g., calendar) or promote general destinations/offers with basic aggregate information such as minimum price ("starting from...") to the customers. This enables the customers to focus on areas/routes/destinations/dates of interest before starting a full shopping flow.

One possible option would be to add to NDC APIs the ability to shop by affinity parameters allowing to return consistent product/bundle data to be used across multiple offer responses and providing a lead-in price per offer per market/destination/route.

An idea of sufficient data is illustrated by the following figure, representing a high-level offer to be used as the basis for complete shopping requests.



Example of a high-level offer providing starting prices, products, cabins and seasonality of a route

Benefits

This section lists the broad benefits that can be expected from addressing extreme look-to-book ratios. Trade-offs, drawbacks for respective tools are covered in the previous sections.

Airlines

- Manage unproductive and redundant shopping requests in a more efficient manner.
- Better management of extreme look-to-book ratios without necessarily resorting to restrictions.
- Expose airline offers both allowing sellers to innovate at the top of the funnel and ensuring airlines maintain some level of control, the extent of which depends on the specific tool.

Travel Sellers

- Freedom to innovate and differentiate at the top of the funnel, within the boundaries of the offers exposed by the airline.
- A wider range of airlines in innovative top of funnel solutions as adoption grows.
- Increase customer reach at the top of the funnel into the primary NDC shopping flow.

Customers

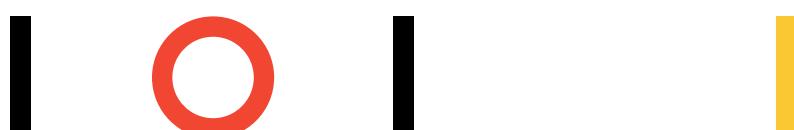
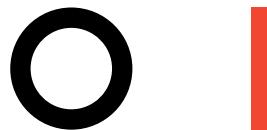
- Consistency of offers throughout the funnel increases customer confidence and results in a better customer experience.
- Access to a variety of innovative experiences during the customer's initial exploration of their travel options.

Next Steps

In adherence to our governance, this exploration activity by The Digital Think Tank will be considered by member airlines (e.g., the Distribution Advisory Council, the Shop-Order Standards Board). If there is an appetite by those airlines to progress the development of a specific tool, then they may want to consider the following next steps:

- Offer Repository:
 - Define business requirements for standard messages necessary for airlines to populate repositories.
 - Explore approaches – feasibility, pros and cons – to provide a feedback loop to airlines (e.g., access to raw shopping requests hitting offer repository, streaming aggregated shopping data back to airlines).
 - Explore ways to ensure it is possible to go back to a regular NDC shopping flow from a selected pre-computed offer in a repository.
- NDC API Evolution.

List the most common use cases not implemented/defined in NDC. Prioritize these use cases and define best ways to support them (e.g., evolution of AirShopping message, creation of a new message).



2022 Exploration

Metaverse

The Metaverse is an up-and-coming topic that the Think Tank wanted to explore this year as this technology could drastically change the way future customers travel. We approached this topic as sceptics and realize this: the multitude of ways the Metaverse develops depends on a series of new technologies and we do not know how it will evolve. There are different ways this could develop before a full virtual metaverse is achieved. In fact, we believe there will be multiple steps before this virtual world, where augmented reality or extended reality will be integrated into our physical world. This world of augmented reality to virtual reality will create customer needs we do not currently know, in addition to effecting areas of operations, delivery of services, and the end-to-end customer journey.

The metaverse may have a large impact on society overall and the entire customer relationship, including brand awareness, storytelling, employee engagement, customer engagement and direct feedback, marketing, and more. The metaverse, and all its hype and buzz around it, has the potential to fundamentally reshape the world around us. If it lives up to its potential, it could combine our digital and physical lives seamlessly, increase interaction intra-individual and between individuals and companies, and finally achieve interoperability between devices and platforms.

Metaverse Fundamentals

The Metaverse is a collective virtual shared space – multiple users can use it and interact at the same time -, created by the convergence of virtually enhanced physical and digital reality. The Metaverse is persistent (it continues to operate and evolves on its own even when a particular user is not connected) and will provide enhanced immersive experiences in the different virtual worlds, realistic enough to create a sense of psychological presence.

A fully mature Metaverse will likely be device-independent (accessible through different interfaces with diverse levels of immersion such as smartphones, headsets, glasses, etc.), decentralized (created as the union of multiple independently owned parts) and interoperable (enabling seamless information exchange or interaction among multiple parties, e.g., enabling to use a single avatar across different Metaverses). The Metaverse will have a virtual economy of itself, enabled by digital currencies, NFTs (non-fungible tokens) or some equivalent.

The Metaverse is starting to be recognized as a potential major disruption which could transform the way we socialize, work, shop, etc. However, there are key challenges to achieve the mature state of the Metaverse, such as: reaching an immersion close to our perception of the real world, creating technical standards to ensure interoperability, developing the necessary governance & regulation, ensuring the availability of infrastructure resources to support Metaverse related technologies.

Technologies needed to converge for the Metaverse

For the true metaverse to exist, technology needs to evolve in order to rise to the challenge. Work needs to be done with devices and infrastructure before the full vision of the metaverse to be attained. This section will explore the key fundamental technologies that are needed to both create and adopt before the metaverse comes to fruition.

At this moment a kind of proto-metaverse exists, a term conceived by Matthew Ball, metaverse theorist, venture capitalist, and CEO of Epyllion. This proto-metaverse currently brings in a profit larger than the music and movie industries combined, and it is the gaming industry. Already there are more than three billion users globally with a total value of more than 200 billion.

The metaverse is built on four building blocks: experience and content (like virtual worlds), platforms, infrastructure and hardware (such as our phones), and enablers (for example cybersecurity).

- We already have computers on our wrists and in our pockets. However, our access is not limited to phone or computer screens. For a truly immersive experience, hardware must be developed. Haptic technology is not currently mature, but augmented reality devices will be the next wave, followed by extended reality (XR). XR devices like glasses, contact lenses, and human/computer interfaces will take some time to come to fruition and experts don't expect this seamless interface between reality and the metaverse for more than a decade.

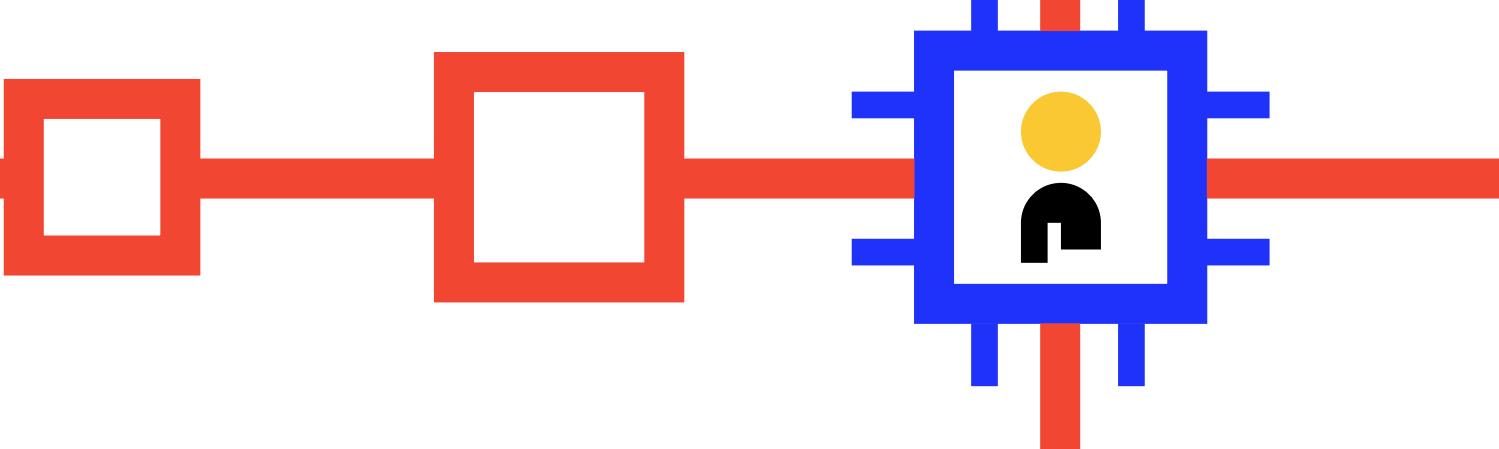
- 5G will be key in connectivity, providing higher bandwidth and lower latency (network infrastructure will most likely need to be improved for this to occur at scale). 5G will provide consistent coverage, access to edge compute and low latency, APIs/SDCs in developer platforms and in business logic, and a network platform. It will also enable more connective devices such as VR headsets, and eventually human/computer interfaces. For the airline industry, this will be necessary to deliver constant and consistency customer experience.
- Blockchain, while not strictly necessary for the metaverse (see Secondlife – around for almost 20 years, flourishing digital economy without blockchain), is an integral part of the decentralized creator economy and especially the interoperability between different worlds. There are some negative feelings round cryptocurrency, however blockchain will help enable the metaverse and could help attain the goals of decentralization. Blockchain offers a single source of truth, where digital assets are issued and can facilitate smart contracts.
- One should not confound the metaverse with Web3 and vice versa. Web3, is the decentralized version of the internet, built on distributed technologies vs. built on servers owned by a corporation. Web3 allows users a greater amount of data privacy and anonymity. While web 2.0 is more information centric, Web3 is more user centric and secure. Web3 is to be decentralized where content creation stays with the owners as opposed the platform that it's on (Instagram doesn't "[C]laim ownership of your content, but you grant us license to use it." Thus, while you own the photo, so long as it is on the platform, Instagram can use your photo for advertising, it can distribute, display, modify, copy, etc. your photo). Web3 relies on AI for a deeper understanding of what the customer wants/ needs, VR and spatial web to blur the line between reality and virtual space, blockchain, and connectivity. Metaverse is about both virtual worlds and a virtually enhanced physical world. It is important to note, however, that a lot of Metaverse concepts are being built on Web3 foundations. While Web3 and metaverse are not synonymous, the current direction being used would see them as complementary.

As one can see, there are different technologies that must evolve and develop prior to wide scale creation and adoption of the metaverse. However, the immense interest and investment in the technology and supporting tech will allow this to happen very rapidly.

Timeline

An Emerging Metaverse is a reality today. However, critical challenges need to be solved to address full potential and reach maturity. At high level, the different Metaverse adoption phases could be the following:

- Emerging Metaverse, (2022-2025). In this phase the immersion level suffers from devices with some limitations (e.g., VR headsets). Also, the level of interoperability remains low, causing siloed experiences. However, we expect most large firms to start investing in the Metaverse, and, to gradually see a greater number of use cases maturing (e.g., workspace, education, etc.). In this phase there is a lack of governance, ethics, or control, with very limited regulatory intervention.
- Advanced Metaverse, (2026-2029). During this phase the early majority could be reached (according to Gartner, by 2026, 25% of the people could spend at least 1 hour per day in the Metaverse). Thanks to affordable interfaces (e.g., glasses), credible and immersive experiences complementing the real world could be a reality. The Metaverse would become a key channel for Marketing and Advertising. Cryptocurrencies and NFTs would be increasingly adopted. In this phase we could expect early national government regulations (e.g., tax, privacy, etc.).
- Mature Metaverse, (2030-2040). Late majority could be reached, with more than 80% of the people and companies in the Metaverse. The immersive technology would allow us to move and feel in virtual world as in the real one (especially thanks to Brain-Computer Interfaces expected by 2040). We could expect a single or limited number of Metaverse(s), with collaborative and interoperable digital worlds. At this stage all industries would have products and services in the Metaverse, working with an autonomous virtual economy and decentralized service providers. In this phase we could expect stronger country-independent governance (e.g., DAOs – Decentralized Autonomous Organizations).



Hype vs Reality

There is a lot of hype around the Metaverse and rightfully so. It's a technology/concept that has been teased for decades. We are finally at the technology level to make it a reality. Metaverse is not the next Internet, however it will be the next evolution of it. As much as many think that 'Everything will be Metaverse', people aren't going to give up living in actual reality but will engage the Metaverse where it adds value. There is also going to be a divergence of who can afford the hardware and who cannot. Underserved markets and people living without certain levels of affluence are potentially excluded from the Metaverse for the foreseeable future.

We should expect a similar fervor as we did in the dotcom and blockchain bubbles. In the 90's everything that was a dotcom immediately got a multimillion-dollar valuation. In the blockchain era it seemed everything was becoming a blockchain company, even some companies that made iced tea. To think that irrational exuberance is not going to follow the Metaverse is short sighted. However, this should not devalue the immense real impacts that were realized once the irrational parts were over. Early entrants to the markets will have their impacts. Some will become the next Google or Yahoo, others will be just memories. Those that embrace the new technology will reap the rewards of customer engagement and loyalty, those that do not will see their customers engage with other vendors.

Some people believe that the Metaverse will create a new reality, a new commerce and a new existence that puts the power in the hands of the people instead of governments. They think it will create a completely open system where only you control your data. This seems unlikely. Much like how the Internet transformed commerce, it did not invalidate the requirements of government, taxation, commerce and rule of law. Governments will still need to protect their citizens from criminal elements, illegal behaviors and undesirable elements. There will still be concerns of identity proving and protection. Money and transactions will still need to be tracked in order to prevent things like theft, money laundering and terrorism.

In a nutshell, the rewards of the Metaverse will be a more immersive and richer environment in order to provide goods, services and experiences to the customer. It eventually will increase operability between systems and make transfer of goods and services whether physical, virtual, or both much easier. It does not change the underlying issues with doing so. It does not change the rules of the game as much as the canvas on which we are able to use. It also allows us to interact with people in ways prior that were impossible. To give experiences and opportunities that are no longer bound by limitations of the physical world and interact with them in a completely new paradigm.

Challenges and Opportunities in Aviation

The metaverse, even in its nascent stage, has an investment of more than US \$120 billion just from January to May 2022 alone (versus the US \$57 billion in 2021). According to McKinsey's predictions, it has the potential to reach ~US \$5 trillion by 2030. In the same study, consumers listed travel as one of the top five activities they are excited about. While the metaverse is still developing, there is much potential to be a very disruptive force.

Use cases that companies are implementing currently including marketing campaigns, product design, all helpful for aviation. There are also risks to not joining the metaverse, especially as more people are used to working virtually, shifting away from face-to-face meetings, and thus travel. However, meetings in the metaverse or events and conferences taking place in the metaverse could pose a problem.

Use Cases

There are many issues that aviation faces today that may be addressed by metaverse and supporting technologies. Considering the described challenges and opportunities that the metaverse can offer for the airline industry, a few potential use cases are described. A group of use cases is presented that has the potential to show value for the airline industry within the current business model. There are, however, numerous more opportunities and even more can arise as the ecosystem develops.

Connecting with Customers

In general, new online platforms provide a multitude of opportunities to connect with customers. One of the biggest opportunities in the metaverse is getting a closer relationship with the customer. As several airlines have shown in the past with the introductions of the internet, social platforms like Facebook, Instagram and TikTok and messaging services there is an opportunity to promote your brand in a new way. This can improve both brand loyalty and brand engagement.

As a customer, you're getting used to checking certain parts of your trip online before engaging in it in the practical world. Examples could be doing a "street view" check of how to walk exactly to a certain shopping mall and where the store is located. The opportunities to first check a collection of products before going to the actual store are becoming part of shopping culture.

The airline customer journey requires the customer to interact with a multitude of involved organizations (airline, airport, border control, connecting airport, shopping). It is well-known that it's not always clear for the customer how to optimally navigate, distinguish and interact with these actors. The metaverse could be a great opportunity to let passengers already virtually make their journey to investigate the questions they have. These checks could be operational such as wayfinding, benefiting the airline industry who often needs to escort passengers to make their connection. Nevertheless, a lot of opportunities could be commercial, showing shopping opportunities at the airport or the benefits of a cabin upgrade on board. It's exactly this interaction between the online world in the metaverse and the practical operational and commercial world where a lot of use cases for the airline industry is viable. These immersive experiences during pre-travel in potential journeys, could eventually also lead to booking it in the Metaverse.

Focusing on Experiences

Leisure travel is picking up faster than corporate travel due to changed perception around online meetings and the growing awareness of the impact of flying on the climate. Airlines investing in this space could be a method to mitigate this risk by being part of a new online meet-up world. Further, the image of the airline industry has taken a hit due to the increased societal focus on sustainability, traveling and promoting travelling/meeting in the metaverse be an interesting alternative and a new way to differentiate your airline brand in a positive manner.

While theoretically metaverse can replace physical travelling, no technology can replace our 5 senses (at this moment). While there is some exploration around this space, haptic technology needs time to mature. Airlines, however, can tap on metaverse right now to bring a "sneak preview" of travelling, new planes, new products, new destination and new experiences, enticing customers to fly.

The XR component of the metaverse could also include more rich experiences for opportunities of geolocation engagement for travelers, and could be a big opportunity, weaving in more phygital (physical/digital) engagement opportunities which leads to a different touchpoint with our customers.

Retailing and Engagement

E-commerce and distribution is probably the largest economic driver of the metaverse, with McKinsey estimating that this alone may have a market impact of US \$2-2.6 trillion by 2030 (gaming has a possible US \$108-125 billion impact).

The largest opportunity for companies will be the addition of a new distribution channel, much like social media has emerged as one the last few years. Aviation is striving to become more customer centric, and the metaverse could be a key enabler of this vision, seamlessly combining and integrating online and offline worlds, and allowing brands to engage with customers outside of travel. Airlines are striving to become retailers, and those who use the metaverse could gain a competitive edge by understanding how to drive and engage customers, create new experiences, cultivate brand loyalty, and rectify problems. In a similar way as, social media transformed from a marketing-only function towards customer interaction over the last years, the Metaverse will not only give opportunity to promote brands in the airline industry but offer opportunities for new ways of interaction. The metaverse will offer new and more direct ways to communicate with customers, as the interface and ecosystem will ensure more engaged interactions. Customers can for example have direct interactions with AI-powered service agents that can be seen as evolved chatbots. Next to that they might be able to discuss their view and questions with other customers, forming a community. Next to that it can be an ideal location for interviewing loyal customers or providing sneak-previews of new products to receive feedback from engaged customers.

Of course, there are interesting challenges in the metaverse, especially in determining what is needed for the metaverse to truly take off. One of the most difficult will be stakeholder alignment, considering the number of public and private players involved that would need to have a common interest to grow the metaverse. It remains to be seen who they will be and what their interests/objectives they have and how they may align. Currently, like any new domain, the metaverse now operates in a legal grey zone, based on legislations that are not fit for purpose. A challenge in the future is what potential legal framework or regulations will come to fruition. Already, the Metaverse Standards Forum aims to encourage and enable the timely development of open interoperability standards essential to an open and inclusive Metaverse.

NFT's

NFT's are the door to something airlines have been trying to develop for years, a marketplace where customers can sell tickets they cannot use anymore, and other customers can buy last minute tickets from other customers who can't fly anymore. For each transaction the airlines will charge a fee creating a new revenue stream. The appearance of NFT's and blockchain allow this marketplace to exist without the need for a physical or virtual space to be set up, which was one of the barriers that prevented airlines to create these spaces. In addition, there may opportunities to collaborate amongst the travel ecosystem players as well as national tourism agencies and airlines. By the metaverse comes to maturity, tickets and PNRs will be a vestige of the past, but in the transition period, airlines will need to link the e-ticket to a new NFT and automate the changes of the ticket holder before the ticket can be used to fly. The future of this technology is still unknown. All we know is that it will add flexibility to the commercial processes in a very secure manner.

Sustainability

One major concern around the Metaverse is the concern of what this new technology is ultimately going to do to the environment. The first inklings of this rose with the emergence of the blockchain cryptocurrency known as Bitcoin. It used a computationally complex mathematical equation as the foundation of its block creation. Creations of new blocks became a race of expensive and power-hungry GPU laden systems fighting to solve the next piece of the equation and win the prize associated with it. Many rightfully questioned whether this is the best and highest use of our already loaded power grid and questions of sustainability quickly surfaced. This is less of a concern as most blockchain has moved on to a proof of stake algorithm.

In current trends, we are seeing a shift away from locally owned servers and more and more work being pushed to cloud computing infrastructure. There are myriad reasons why this is happening, but the main ones are due to lower cost of ownership, lower cost of product offerings, easier maintenance, and greater ability to expand one's footprint globally. Google, Amazon, Microsoft, and Oracle are just a few of the major players that are building massive datacenters in order to provide these types of services. Although these datacenters require large amounts of power, they actually operate at extremely high efficiency ratings. They are also consciously being built in order to leverage renewable, green energy sources. Not only is this better for the environment, but these companies have realized that investing in these types of energy sources also greatly impacts their bottom line in running these facilities. The greatest cost of operating these large-scale datacenters is not in materials, computers or people, but power. Therefore, utilizing a renewable first policy not only greatly benefits them, but also the environment.

In the last few decades, we have seen a rise in things such as Software as a Service (SaaS) and Platform as a Service (PaaS). These have become popular to solution providers because it allows businesses to quickly integrate pieces of different solutions to create new offerings without having to build everything themselves. Many are believing that the next evolution of this will be Metaverse as a Service (MaaS). Fundamentally these will probably be offerings of the Cloud Providers in order to allow easy transition and building of Metaverse functionality and offerings. It will also create stickiness to the Cloud Provider as businesses will not want to switch there MaaS from one toolkit to another. Ultimately, this will help ensure interoperability and utilization of the efficiencies that the datacenters' bring.

Another part of the sustainability discussion revolves around the hardware components enabling the Metaverse. Whether these are headsets, glasses, gloves or various other IoT devices they all have their own unique footprints on the environment. Fundamentally there are two mains aspects that are required to make the Metaverse work: computational power and networking bandwidth. The rise of computer based gaming created a unique hardware component that was not present in early computers, the graphical processing unit (GPU). The GPU was created in order to offload specific type of calculations from a computer's Central Processing Unit (CPU). These types of calculations were used heavily in graphically intense calculations and therefore allowed for an optimization/specialization of function. In today's world most cellphones in the market now even have GPUs in order to provide this type of functionality.

It is appropriate to assume that as Metaverse adoption increases there will be technologies created to specialize in the unique problems that will have to be solved and will do so in an efficient manner. However, the advent and adoption of the headsets are seen to potentially have an increased beneficial impact to the environment. Enabling virtual work environments could reduce the need for people to commute to a centralized office or creation of physical goods versus digital ones. Many industries will be potentially revolutionized by this technology. Everything from viewing a home to test driving a new car could potentially be done in the Metaverse, giving a similar experience without having to be there in person.

Blockchain and cryptocurrency technology are also seen as a foundational component of the Metaverse and transactions done there. The main reason for this is due to the immutable ledger and distributed nature of these technologies. They are made for distributed networks in a zero-trust environment and therefore perfectly suited to be used.

Notwithstanding the energy consumption and e-waste issues, blockchain technology due to its immutable ledger capabilities can also support environmental protection. In particular, it can offer opportunities to make existing consumption and production processes more transparent, which could enhance their sustainability.

Future of Travel in the Metaverse

When writing about the future we must always be cautious. The world of aviation in 2019 would have never expected a three year paralysis just around the corner, so we must always look at the wider picture to understand what is coming and how our lives will change in order to adapt to new status quo.

Web 3.0 is no longer a proof of concept but a reality. This reality is at its infant stages but it's quickly growing and expanding towards what we already know is the evolution towards Web 4.0, commonly known as the Symbiotic Web. It is worth clarifying the Metaverse is just an element of Web 3.0, but Web 3.0 is much wider in form and structure.

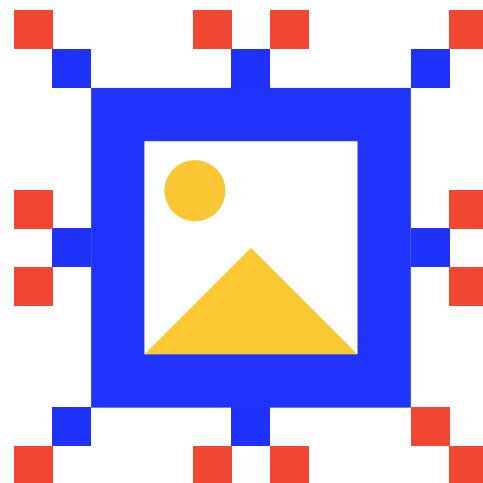
Focusing on the Metaverse, the travel industry is shyly looking at these technologies with very skeptical eyes although McKinsey recognizes that 62% of respondents to a survey were excited or very excited by the possibility of travel in the metaverse, especially the ability to visit "places I can't physically go – including space". The Metaverse itself is seen only as a marketing opportunity rather than a commercial and operational one. As we have already explained, the Metaverse is a network of virtual worlds focused on social connections. It's a virtual environment currently under construction where anyone has the power to create, own and share content in a way that had never been possible before. Opportunities for airlines are immense. Having a virtual world where airlines could build unlimited scenarios for testing, training, optimizing, collaborating, and connecting with the customers. As airlines increase their investment in the Metaverse we could see a high number of developed scenarios airlines could use to make strategic and operational decisions and provide services in advance of demand. Becoming proactive rather than reactive will not only be easier, it will be demanded by customers who see other industries use this technology to make their lives easier.

The Metaverse will be a universe made of multiple realities where real world operations could merge with virtual processes (check-in, selection of seats, customs, etc.). Technologies like Blockchain, Digital Identity and biometrics will combine to create the new architecture of trust and allow these processes to run faster and more efficiently.

Travel itself will evolve. Working relationships still will need to be built and leisure travel will still be all about the experience. It is still and will always be a physical activity, but customers will be able to experience what it is they are going to see beforehand. The culture of the selfie will evolve into a culture of experiences where friends and family will be able to share moments and feelings in a more inclusive manner. Airlines will need to link their services to these experiences to attract more customers into flying with them to these destinations. Almost everyone connected will be a potential influencer, and the onboard experience will be even more important.

New communities will be created with exciting and creative content being shared across the Metaverse. Opportunities will raise from these communities in several forms, from marketplaces to exchange tickets, to sharing experiences and recommendations. NFTickets will open a new opportunity for customers to exchange, buy and sell their tickets in an open environment without the need of a marketplace platform. This will generate new opportunities and risks for the airlines.

Internal processes like training, interviewing, and hiring will see an integrated approach mixing both the real and the virtual world with a depth and scope increasingly adapting to the new environment capabilities and with a higher sense of community and interaction. The metaverse will become a new channel where customers will be able to buy flights, book experiences, hotels and even taxi rides. Brand will be even more decisive for customers and will become a bigger differentiator. Customers will demand a higher level of integration with other industries as well as a superpersonalized crossover experience.



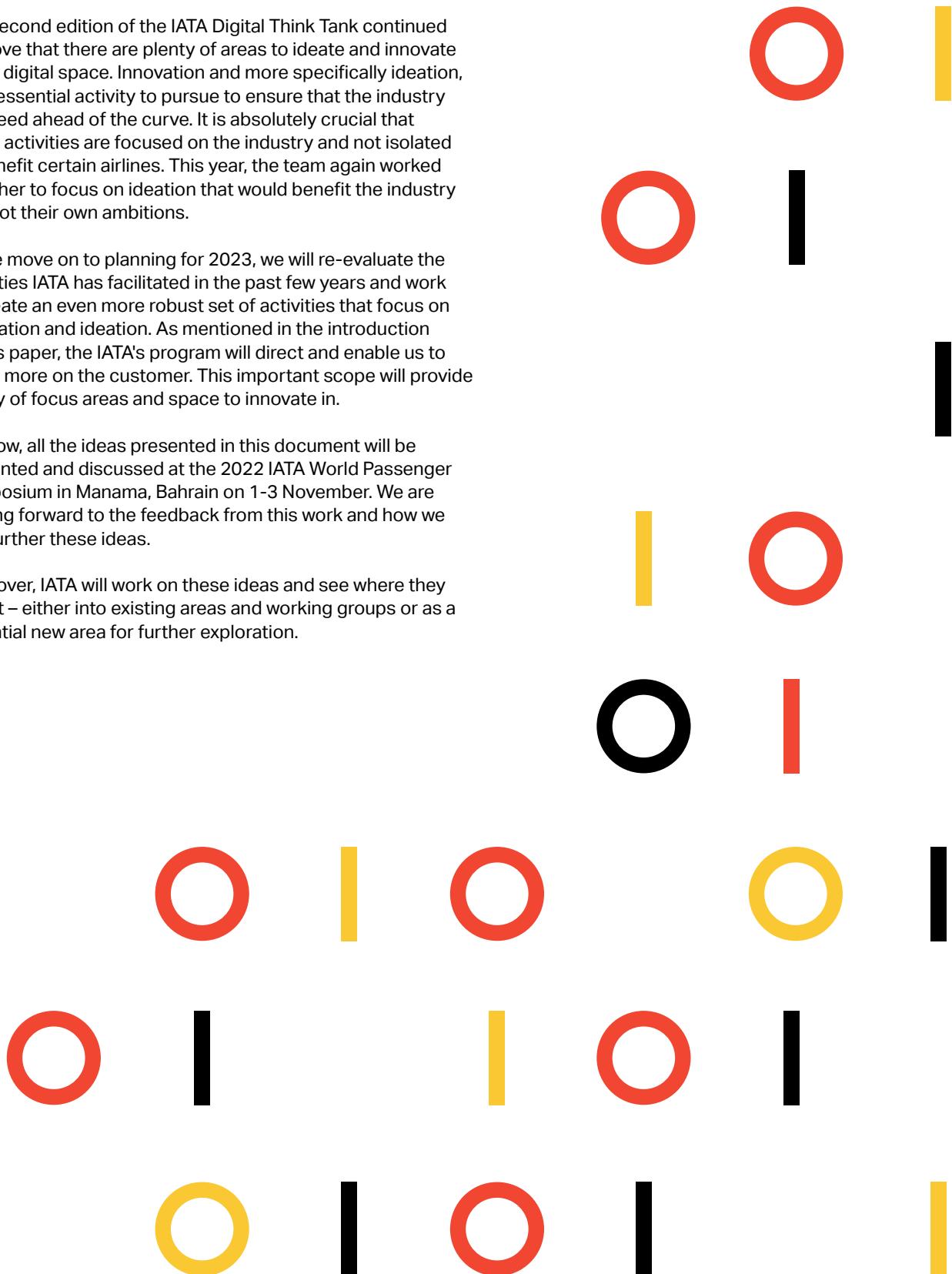
Conclusion

The second edition of the IATA Digital Think Tank continued to prove that there are plenty of areas to ideate and innovate in the digital space. Innovation and more specifically ideation, is an essential activity to pursue to ensure that the industry is indeed ahead of the curve. It is absolutely crucial that these activities are focused on the industry and not isolated to benefit certain airlines. This year, the team again worked together to focus on ideation that would benefit the industry and not their own ambitions.

As we move on to planning for 2023, we will re-evaluate the activities IATA has facilitated in the past few years and work to create an even more robust set of activities that focus on innovation and ideation. As mentioned in the introduction of this paper, the IATA's program will direct and enable us to focus more on the customer. This important scope will provide plenty of focus areas and space to innovate in.

For now, all the ideas presented in this document will be presented and discussed at the 2022 IATA World Passenger Symposium in Manama, Bahrain on 1-3 November. We are looking forward to the feedback from this work and how we can further these ideas.

Moreover, IATA will work on these ideas and see where they can fit – either into existing areas and working groups or as a potential new area for further exploration.



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