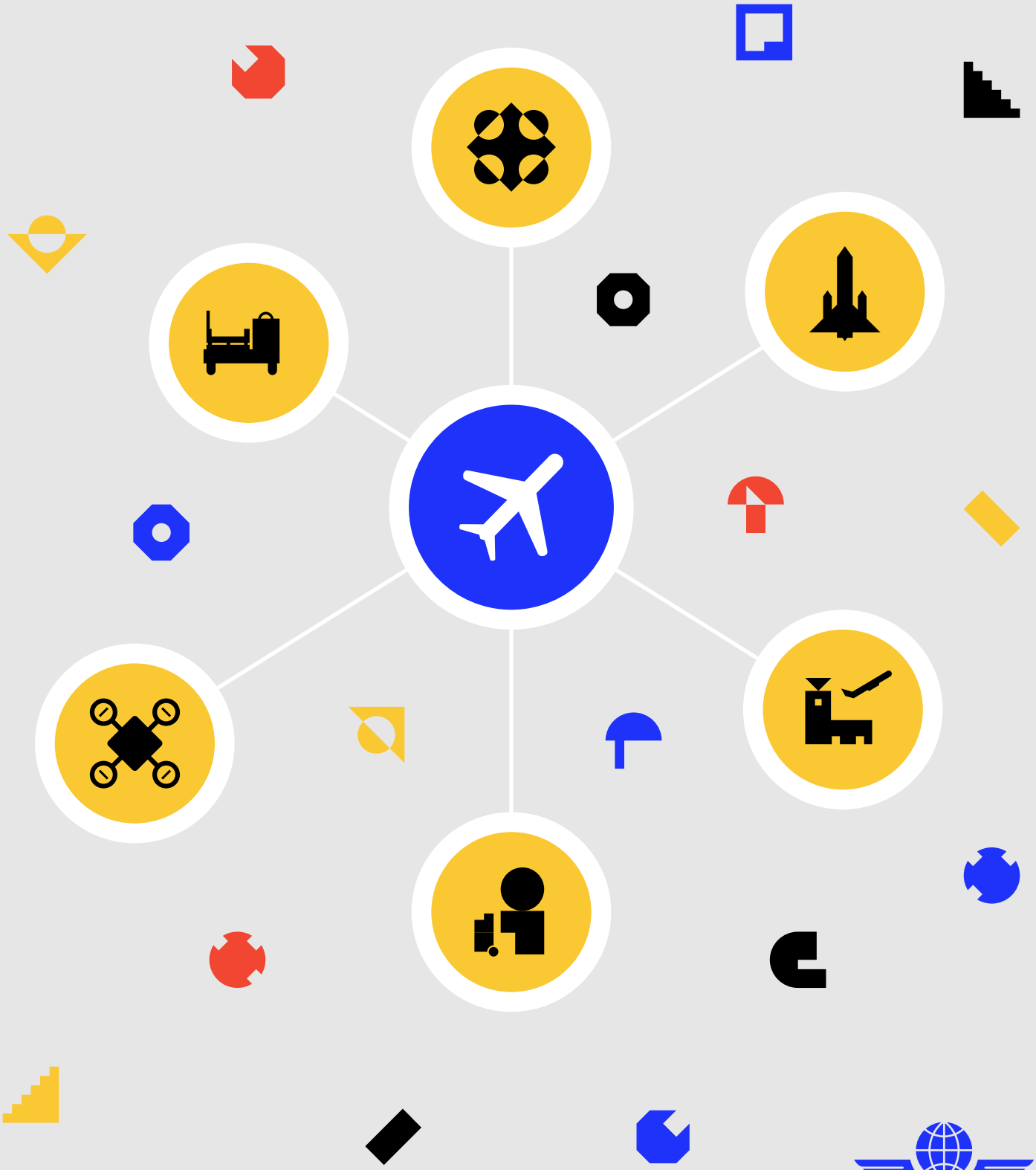
New Aviation Ecosystem
Roadmap



IATA

Background

The flying public increasingly expects environmentally friendly, digital and personalized travel options. Airlines are investing in new aircraft technologies (eVTOL, eSTOL, supersonic, commercial space vehicles, single/remotely piloted, new energy powered aircraft). However, legacy infrastructure and regulations continue to lag behind. While operations may start slowly and in specific parts of the world for eVTOL aircraft, market projections anticipate exponential growth rates from 2025 onwards. At the same time, there is a growing demand for remote inspections and surveillance of critical assets and infrastructure, including at airports. Future airport concepts include autonomous ground vehicles and ground equipment. Changing consumer and purchasing behaviours are prompting the need for faster parcels deliveries. Combined with the anticipated developments in automation on the ground and on-board aircraft, this will require a complete re-think of the aviation system.

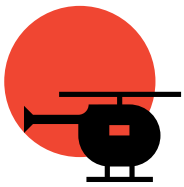
To prepare for the future ecosystem and initiate the dialogue on required industry actions, IATA has established a Task Force with representatives from the industry to map out key challenges and opportunities. This roadmap developed with inputs of the Task Force, will guide different industry activities to ensure seamless operation in the future operational environment. There are efforts focusing on alternative fuels and associated infrastructure, so while this is referenced here, the focus of this roadmap is transformation in on board aircraft automation and how that will change the aviation system.

Future Aircraft Technologies

In the next 20 years, there will be an increased use of automation, robotics, uncrewed aircraft (UA), and artificial intelligence (AI) in aviation. New entrants including all sizes of UA, high altitude balloons, supersonic and hypersonic aircraft, and advanced air mobility (AAM) are being pursued by companies with significant investments. At the same time, future crewed aircraft designs are expected to include higher levels of automation. Automation is also likely to expand beyond a single flight into systems enabling optimization of large fleets and fleet management with multitudes of interdependencies and constraints.

In addition, not all uncrewed aircraft will be operating at low levels.For example, some AAM operations are expected to occur above 400 feet. Upper airspace operations will involve aircraft which have varying performance levels, from balloons with few manoeuvring capabilities to supersonic and commercial space aircraft that will cross the airspace much faster. The duration of the operations in upper airspace will also differ from a couple of hours to months. We will also see in the next decade an increased use of alternative fuels, from SAF to hydrogen powered aircraft. The future aircraft technologies will require new infrastructure and new procedures. What needs to be identified is what infrastructure & standards will be required, when they will be needed, and how to pay for the new infrastructure.

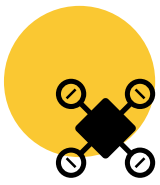
The future aviation ecosystem should be designed to meet the evolving demands of diverse operators in a performance-based, cost-effective way, that is safe, secure and efficient. This transformation will affect not only the system's architecture, but also how it is regulated. The future ecosystem will require fewer human tactical intervention and will allow for the free flow of information between trusted users, which will include new types of service providers and operators. The aviation supply chain will include new players that come from outside the aviation system.



Piloted eVTOL/eSTOL

Remotely piloted & single piloted

Alternative energy/fuels



Uncrewed/autonomous aircraft

Space/supersonic aircraft

Timelines

The timelines indicated in the roadmap reflect when aircraft technology is expected to operate to scale and when the related operational and infrastructure need to be ready to support that operation. The milestones that are mapped out indicate completion date.

2023 – 2027

Concepts & Trials

Learn from trials and sandboxes to identify future system requirements

Initial Operations

Operations commence without major change to the current system – additional learning

2027 – 2035

2035 – 2040

Operation at Scale

Operations at scale alongside evolution of regulations, infrastructure, operational procedures

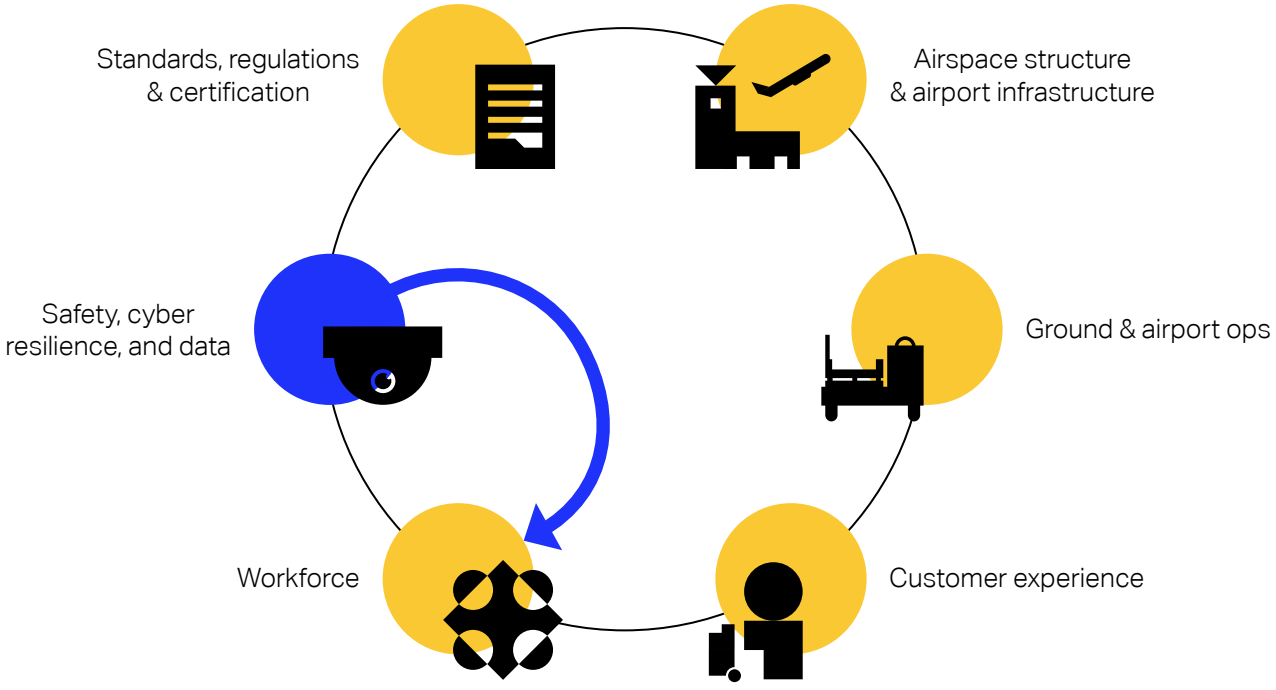
System Maturity

System automation and highly automated / autonomous operations

2040 – 2045

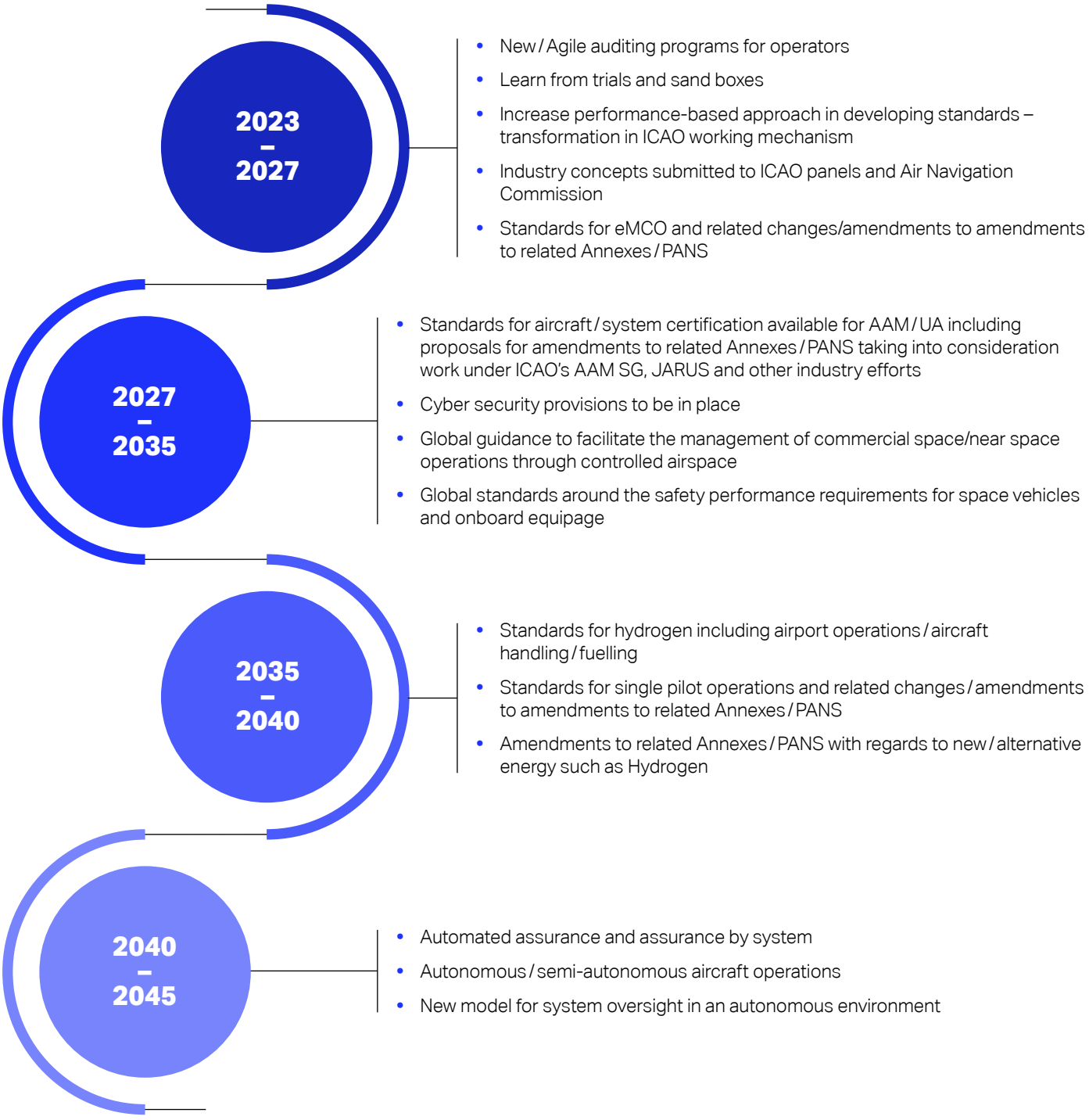
Roadmap Streams

The roadmap will include 5 main streams that align with the future evolution of aircraft technologies. Safety, cyber security and data will be enablers across the different streams.



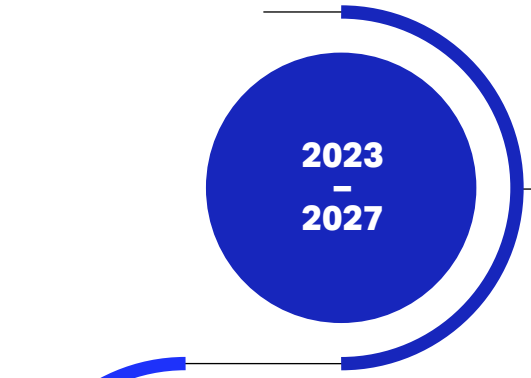
Standards, Regulations and Certification

The current aviation cycle for developing any new standard or proposal will need to be adapted to meet the high pace of innovation and technological advancements. At the same time, it is important to initiate discussions now about future operational scenarios and assess compatibility with some of the existing requirements for crewed aircraft. For the new types of operations regulations that define the roles and responsibilities in an autonomous environment, specifically for oversight and safety assurance, with detailed system redundancy will be required. Additionally, regulations need to be developed for safety reporting and protection, using more autonomous systems. Audit programs to assure safety and compliance of the more diverse types of operations will need to be more agile and adaptable, to allow the accelerated entry of new operators into the aviation system.

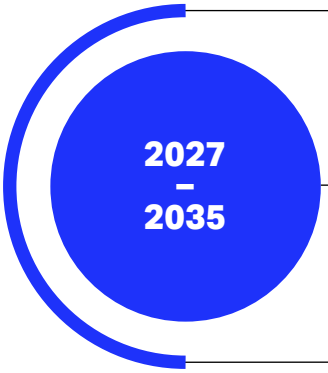


Airspace Structure and Airport Infrastructure

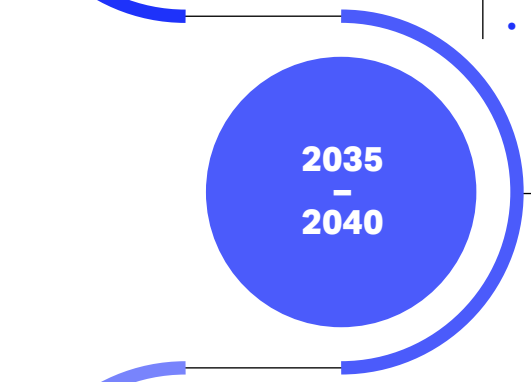
With the anticipated increase in the number and diversity of operators in an airspace, there will be a shift from a human-centric construct (where automation is only supporting decisions) to a system-centric construct (where automation will carry out routine tasks). This requires a re-visit of some of the underlying assumptions governing how traffic is managed and infrastructure design.



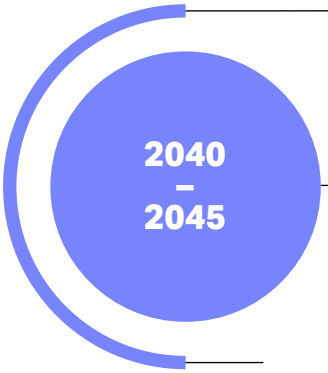
- Automation supporting operation – segregation
- Automation in ATM as a supporting capability with new entrants operating in segregated airspace which requires allocation of air corridors for AAM/UA operators
- Review of industry concepts related to automation and autonomy in airspace
- Global standards agreed for design/architecture of vertiports
- Regional / local development of vertiports against local regulations / requirements
- ICAO's vision for AAM which will drive work in different panels and recommend standards, e.g., flight rules, airspace classes, etc.
- The development and testing of new traffic management services tailored to AAM, including value-added and future mandated services
- Vertiports development within city infrastructure and power grid investments & limited vertiports collocated with regional airports



- Supervised automated system in ATM with limited mixed mode operation
- Ramp-up of hydrogen infrastructure at airports for ground operations and road transport as a steppingstone for hydrogen aircraft
- Global standards agreed for design/architecture of space ports for commercial use
- Integration of AAM tailored traffic management services, including UTM, with ATM
- The introduction of AAM tailored, value-added traffic management services supporting interaction between early fleet and vertiport operators
- Implementation of initial regulated services



- Maturity of automation in the ATM system – full integration of new and emerging operators
- Global provisions (as required) for traffic management and vertiports design / operations are available
- New airport concepts / design integrating new operators
- Hydrogen storage scaled-up for aviation use, and liquefaction facilities at select airports
- Seamless airspace, maintain separation standard irrespective of location with enhanced surveillance and communications capabilities



- Autonomous ops in airspace with minimal human intervention
- Integration of ATM, UTM and STM

Ground and Airport Operations

Future ground and airport operations are characterized with limited, almost no, human intervention to manage procedures. From check-in kiosks to autonomous ground vehicles, the journey through an airport and onto the ramp will be managed by technology and supported by data. This will require a shift in ensuring safety and security. Cyber security and aviation security will be critical especially with the interface between vertiports and airports. Remote inspection of critical infrastructure, including navaids, assets and airport facilities will be done digitally and using remote technology.

2023 – 2027

- Global standards for vertiport operations are available, including:
  - Security standards for passenger and baggage screening
  - Baggage handling across the whole journey (vertiport-airport-vertiport)
- Autonomous ground support vehicles are tested and use in some airports and for specific operations

2027 – 2035

- Mutual recognition of standard ground operating procedures and security checks
- Autonomous ground support vehicles start operating and data from trials are used to optimize future airport design
- Autonomous warehouse operations and sorting facilities supported by industry best practices
- CDM & A-CDM that encompasses all users (e.g. CDM/A-CDM for airspace operations)

2035 – 2040

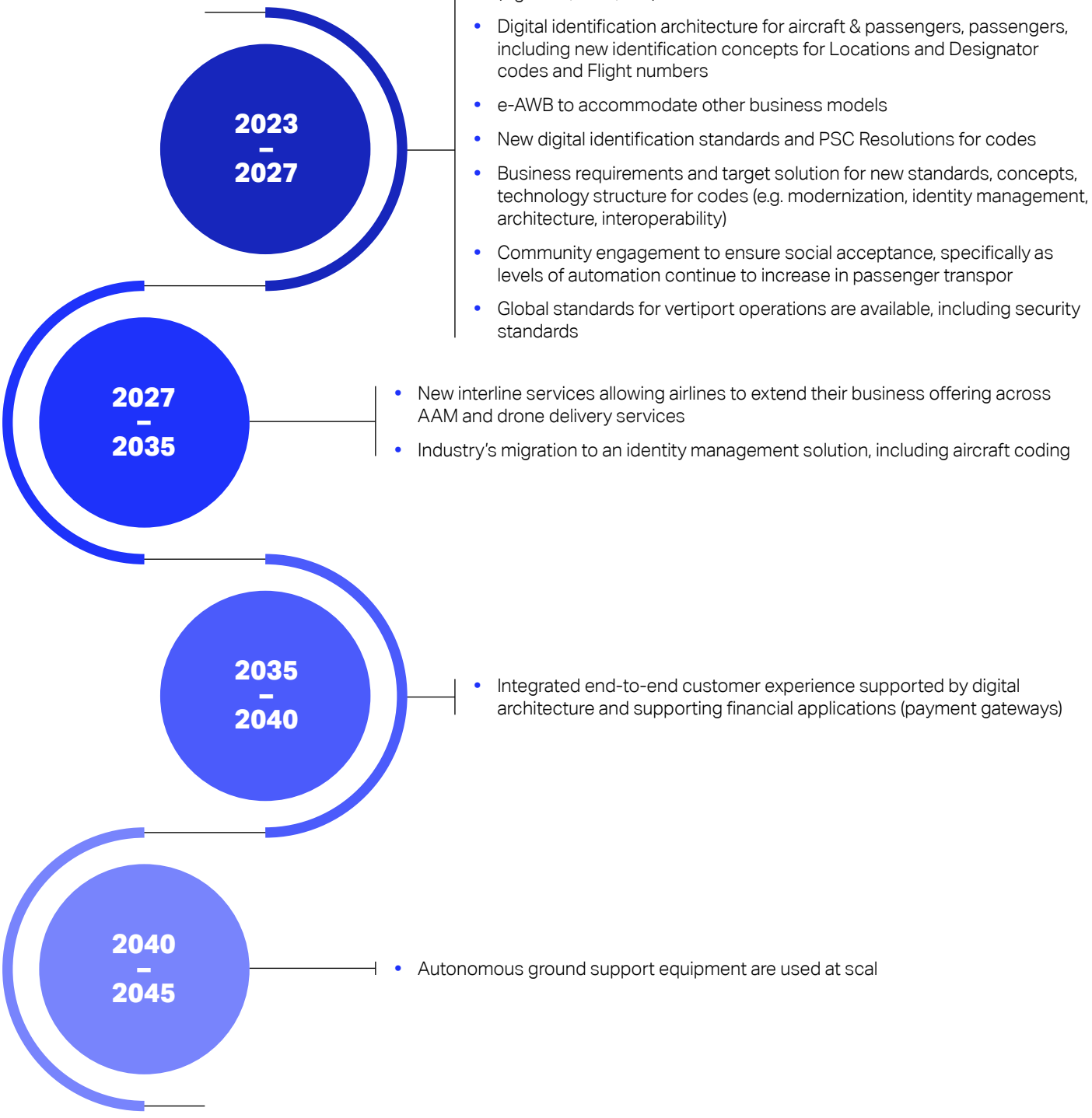
- Autonomous ground support vehicles are operating at scale requiring new ground procedures and manuals to be available
- Automated aircraft fuelling / re-fuelling requiring new standards and operating procedures (manuals to be ready) – specifically for alternative fuels such as hydrogen

2040 – 2045

- Full automation in terminal and air side with supporting standards and best practices available to ensure safe operations
- Safety and quality assurance standards and procedures are available to support a highly automated operational environment

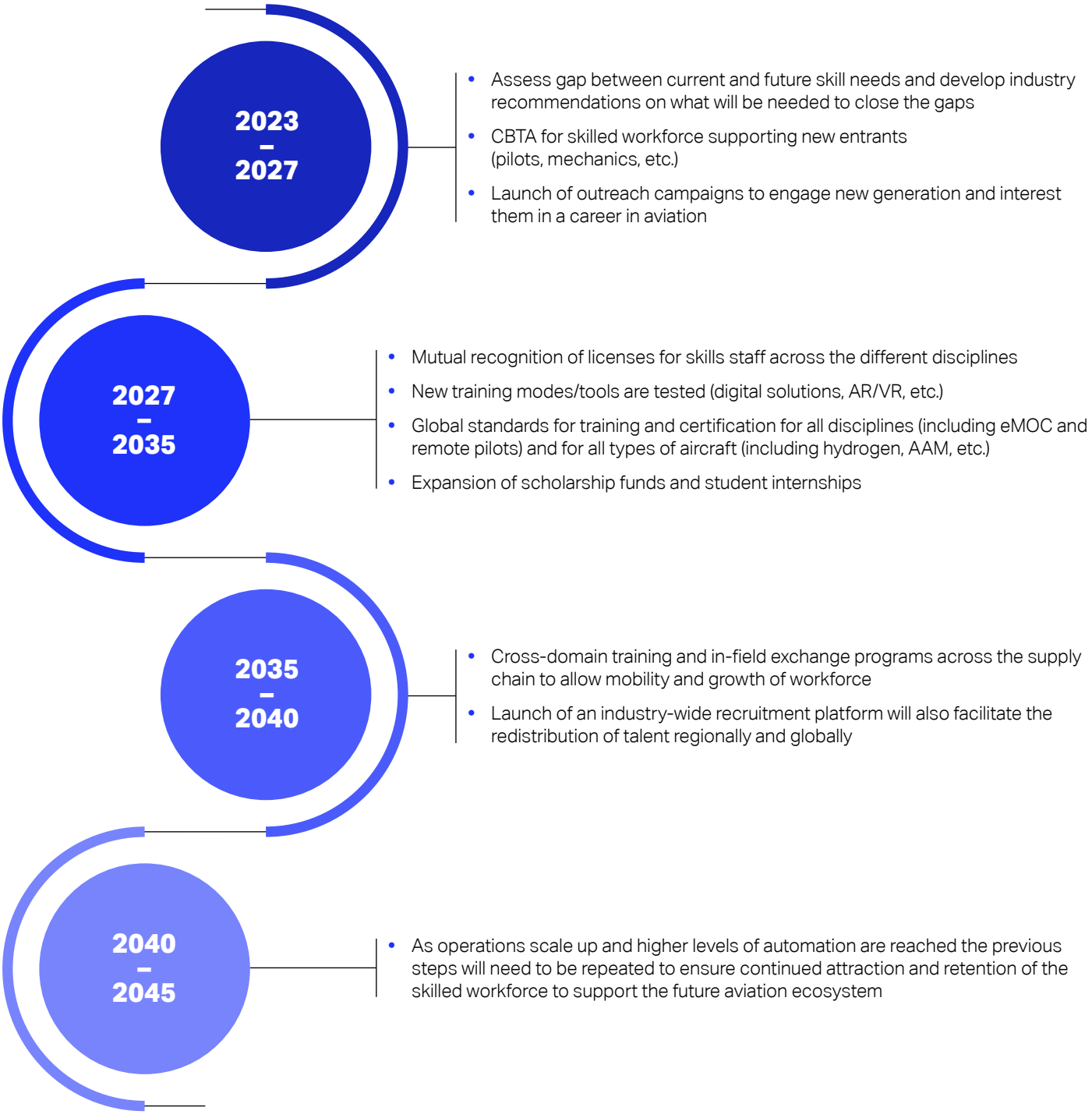
Customer Experience

The flying public want to travel greener, and safer, and move seamlessly and without delays through an airport. These expectations will fuel technological development in the customer experience, be it to travel or for e-commerce. The future aviation ecosystem will enable enormous amounts of information to be shared across the supply chain, thereby contributing to smoother and safer flying. In the future, the passenger journey is no longer from an airport to another, but rather door-to-door. Purchasing behaviours and e-commerce have drastically changed in the past three years. The need for same day delivery of packages to one's home has grown exponentially.



Workforce

The combination of human intelligence and of artificial intelligence, supplied by a highly automated systems, will be working together in the future aviation ecosystem. This will require re-skilling and upskilling of existing workforce in aviation, as well as new strategies for attraction and retention of talent that can meet the future needs.

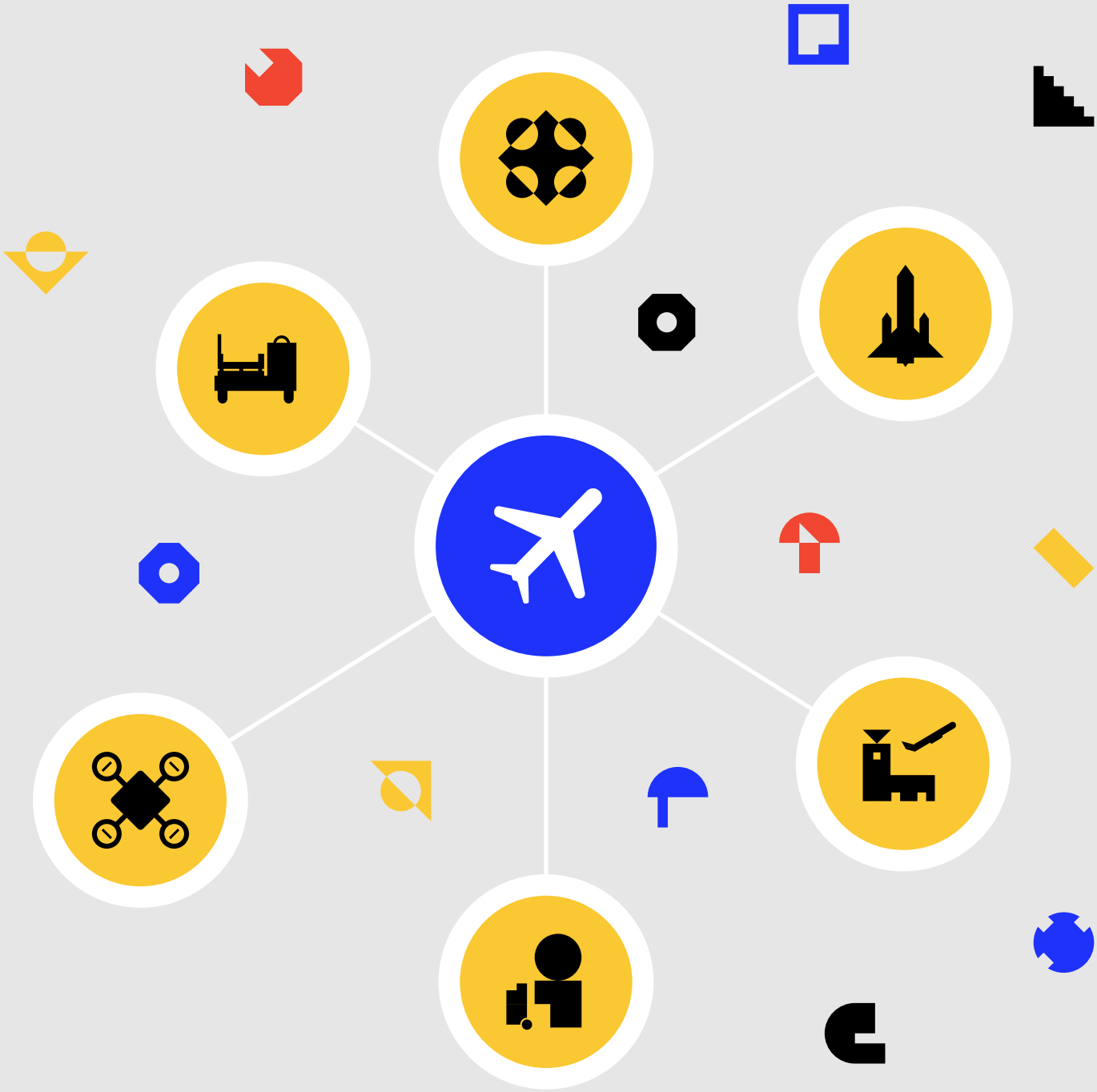


Beyond the Roadmap

The experts taking part in the IATA New Aviation Ecosystem Task Force will participate in focus group discussions to develop industry standards as laid out in the roadmap. The work of the Task Force will also provide an input to existing platforms and groups, such as ICAO's Advance Air Mobility Study Group (AAM SG) and the concerned ICAO panels and groups. Where applicable, industry will also use the direct submission process to provide input to ICAO's Air Navigation Commission (ANC). Participation in the New Aviation Ecosystem Task Force is by invitation only.

Furthermore, the task force will consider in its future work the impact of the future aircraft systems on legacy airlines in the areas of operating environment, aircraft selection and workforce resources.

For questions and inquiries about this roadmap, please send an email to iata_uas@iata.org.



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