SESAR JOINT UNDERTAKING

SESAR 3 Joint Undertaking

BIANNUAL WORK PROGRAMME

2024-2025

Second amendment

EUROPEAN PARTNERSHIP

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SESAR 3 Joint Undertaking

Bi-Annual Work Programme for years 2024-2025 - Second amended version

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This document is the second amended version of the Bi-Annual Work Programme of the SESAR 3 Joint Undertaking (SESAR 3 JU) for the 2024-2025 period.

This work programme covers 2024 and 2025. It is therefore referred to interchangeably as the 'annual work programme' and the 'bi-annual work programme'.

The information contained in this work programme (including the list of topics, budget and planning of calls) may be subject to updates. Any further amendments to the work programme will be made publicly available after its adoption by the Governing Board.

The Single European Sky ATM Research 3 Joint Undertaking is funded by the European Union, the European Organisation for the Safety of Air Navigation (EUROCONTROL) and other members listed in Annex III of Council Regulation (EU) 2021/2085.

In accordance with Council Regulation (EU) 2021/2085 and with Article 33 of the financial rules of the SESAR 3 Joint Undertaking, the work programme will be made publicly available after its adoption by the Governing Board.

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Message from the Executive Director

I am delighted to share with you the work programme for the SESAR 3 Joint Undertaking for the period 2024-2025. The priorities detailed in this programme reflect our mission to deliver the Digital European Sky, and we firmly believe that with the activities planned for the next 24 months, we can make significant progress to reaching this goal.

Topping the list of priorities will be the update of the European ATM Master Plan - the official roadmap driving ATM modernisation efforts – which will focus on making Europe the most efficient and environmentally friendly sky to fly in the world. Furthermore, we will deliver to the European Commission a proposal for a new Common Project, identifying the best-in-class SESAR 2020 solutions for harmonised and synchronised deployment across Europe.

In order to feed the SESAR innovation pipeline, we will launch a new wave of exploratory and industrial research calls, ensure the successful delivery of our awarded projects and generate a critical mass of early movers. Collaboration is equally key, and over the course of 2024-2025 we will remain committed to expanding our membership base, building partnerships, and fostering synergies in high-priority areas linked to our mission.

Transparency and accountability are paramount in our organisation, and in this regard, we will strive to secure a positive outcome for our mid-term review under Horizon Europe. On the global stage, we will actively engage with international partners on global harmonisation and interoperability as we approach the 42nd Assembly of the International Civil Aviation Organisation in 2025.

Our commitment to sustainability and digitalisation goes beyond our research and innovation programme into the heart of our own operations. During the period, we will also seek to transform our organisation into a greener and more digitally advanced workplace.

The work programme is a collective commitment, and I want to express my thanks to our members, partners and the broader community for their unwavering support. You can count on the SESAR 3 Joint Undertaking and its competent and motivated staff to deliver this work programme.

Andreas Boschen

Executive Director of the SESAR 3 Joint Undertaking

Chapter I – Introduction

1 Mission statement of the SESAR 3 Joint Undertaking

The SESAR project is the technological pillar of the Single European Sky (SES), which seeks to reform the European ATM system and improve its performance. The SESAR 3 JU oversees the definition and development phases of the SESAR project, working to ensure the delivery of solutions that are ready for deployment. It builds upon the experience of the SESAR Joint Undertaking and the successful implementation of the SESAR 1 and SESAR 2020 R&I Programmes. The goal of the SESAR 3 JU is to deliver the Digital European Sky (DES), a vision seeking to transform Europe's aviation infrastructure enabling it to handle the future growth and diversity of air traffic safely and efficiently, while minimising environmental impact. This will make air transport smarter, more sustainable, connected and accessible to all civil and military airspace users, including new entrants.

The SESAR 3 JU's mission statement is: "**to accelerate through research and innovation the delivery of an inclusive, resilient and sustainable digital European sky**":

- accelerate – reducing the time to market through focused and agile R&I, supporting faster transition to deployment through an extended innovation life cycle;
- inclusive – integrating and connecting all types of air vehicles and users, including civil and military, manned and unmanned;
- resilient – enabling flexible, scalable, safe and secure ATM that can withstand disruptions in the aviation system;
- sustainable – establishing Europe as the most efficient and environmentally friendly sky to fly in the world.

SESAR's vision is to **make Europe the most efficient and environmentally friendly sky to fly in the world**. By doing so, the SESAR 3 JU not only delivers on the SES priorities, but it also contributes actively to the overarching EU objectives set out in particular in the "Sustainable and Smart Mobility Strategy", the "European Green Deal" and the "Europe fit for the digital age" priorities. This contribution is particularly notable in relation to the ambitious target of decreasing the carbon footprint of the transport sector in order to achieve climate neutrality by 2050.

2 Background and link with the European ATM Master Plan and the Strategic Research and Innovation Agenda

The reform of ATM in Europe is imperative to cope with air traffic growth, the climate challenge and with significant unforeseen traffic variations (such as the one caused by the COVID-19 pandemic). This requires changes allowing operations to take place under the safest, most cost- and flight-efficient and environmentally friendly conditions, as well as measures contributing to the reduction of aviation emissions. The European ATM Master Plan and the Strategic Research and Innovation Agenda (SRIA) offer a strategic approach to implement the transformation of the ATM and frame the action of the SESAR 3 JU.

2.1 The European ATM Master Plan: a roadmap to the Digital European Sky

The European ATM Master Plan, endorsed by the Transport Council for the first time in 2009[1], is the main planning tool for ATM modernisation across Europe. It defines the vision and objectives of the SESAR project and aims at delivering the DES, characterised by a fully scalable traffic management system capable of handling growing air traffic, both manned and unmanned, in a safe and sustainable way.

Through an approach comprising four progressive phases (A to D), the European ATM Master Plan connects ATM R&I activities with deployment activities and scenarios to achieve the SES performance objectives. It also presents the innovation pipeline through which promising ideas are explored and then moved out of the "lab" when they have reached maturity, to be deployed as solutions delivered to the aviation community.

The SESAR 3 JU is in charge of the stewardship of the European ATM Master Plan, including its updates and the monitoring of the SESAR project. The fourth edition of the European ATM Master Plan[2], published in 2020, includes a roadmap indicating how and when the SESAR vision will be deployed. To address the rapidly evolving landscape of the aviation sector, the update campaign led by the SESAR 3 JU and involving all categories of stakeholders, took place in 2023-2024. This updated Master Plan will, in turn, guide the future activities of ATM innovation as from 2025.

The new ATM Master Plan represents a bold and ambitious vision for the future air traffic management in Europe. It calls for a strong focus of the entire sector on market uptake activities, through Strategic Deployment Objectives (SDOs). The SDOs, 10 in total, are based on SESAR solutions already delivered or in the pipeline and address essential operational changes covering ATM functionalities, including a new service delivery model, that need to be rolled out between 2025 and 2035. Focusing on these 10 SDOs and ensuring the timely deployment and operational integration of SESAR solutions is the path to achieve the Digital European Sky. The new ATM Master Plan also introduce Development Priorities (DPs) that focus on the exploratory and industrial research required to deliver new technological solutions aligned with the performance ambitions of the SES. The 12 DPs cover the prioritized actions needed to develop future ATM functionalities and roll-out phase D, supporting the long-term vision of where we want the sector to be by 2045.

Phase D of the new ATM Master Plan introduces several new challenges, including the need to integrate higher levels of automation and connectivity, further transition to trajectory-based operations, implement dynamic airspace management, and integrate new and green aviation technologies such as zero-emission aircraft, all while keeping the role and function of human operators central. The new ATM Master Plan recognizes these as pressing R&D challenges that require addressing cybersecurity risks, ensuring seamless multi-link communications, and integrating innovative air mobility (IAM) solutions like drones and air taxis into an already complex airspace. The objective is not only to enhance operational efficiency and safety but also to ensure that Europe's air traffic system evolves in a sustainable and secure manner, meeting both environmental goals and growing traffic demands. Achieving this vision will demand the commitment and collaboration of all

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[1] Council Decision 2009/320/EC, Endorsing the European Air Traffic Management Master Plan of the Single European Sky ATM Research (SESAR) project, OJ L 95, 9.4.2009, p. 41.

[2] Published for the first time in May 2008 (and endorsed by the Transport Council in March 2009), the European ATM Master Plan has been updated in 2012, 2015 and 2020, through strong collaboration between all ATM stakeholders.

stakeholders, to make Europe the most efficient and environmentally friendly sky to fly in the world and keep it at the forefront of global air transport.

2.2 The Strategic Research and Innovation Agenda

The SRIA links the ambitions of the SESAR 3 JU to the European Commission's Multiannual Financial Framework and the Horizon Europe Programme. It presents the strategic R&I roadmaps for the years 2021 to 2027 supporting the implementation of the European ATM Master Plan and the delivery of the DES Programme. These roadmaps correspond to a number of measurable objectives and outputs for this time period aiming at further modernisation of Europe's ATM capabilities. The SRIA identifies the following 9 flagships (and their 59 related R&I needs), and introduces roadmaps for their implementation, with objectives and associated output measurements:

1. connected and automated air traffic management;
2. air–ground integration and autonomy;
3. capacity on demand and dynamic airspace;
4. U-space and urban air mobility;
5. virtualisation and cybersecure data-sharing;
6. multimodality and passenger experience;
7. aviation Green Deal;
8. artificial intelligence for aviation;
9. civil/military interoperability and coordination.

These flagships are the basis for identifying future SESAR solutions for the transformation of the European ATM system and the delivery of the DES. Therefore, the calls for proposals launched under the DES programme are mapped against these flagships to ensure an adequate coverage of the priorities defined in the European ATM Master Plan.

3 Strategy for the implementation of the programme

The DES programme is structured into three main R&I phases: exploratory research, industrial research and validation, and digital sky demonstrators. The SESAR 3 JU operates through a holistic and interconnected innovation pipeline, based on these three R&I phases, comprising a continuous cycle of definition, development, and deployment phases. This integrated approach allows the seamless progression of ideas from exploration and conceptualization (low TRL) to real-world application.

The pipeline is constructed from four categories of activities; categories 2 and 3 are within the industrial research and validation phase:

1. exploratory research (TRLs 0–2), funded under Horizon Europe for the EU part;
2. industrial research and validation (TRLs 3–6), funded under Horizon Europe for the EU part;
3. fast-track innovation and uptake (TRLs 2–7), funded under Horizon Europe for the EU part;

4. Digital Sky Demonstrators (TRL 8), funded under the Connecting Europe Facility (CEF) for the EU part[3], in collaboration with CINEA.

The SESAR innovation pipeline and its four categories of activities are shown in Figure 1.

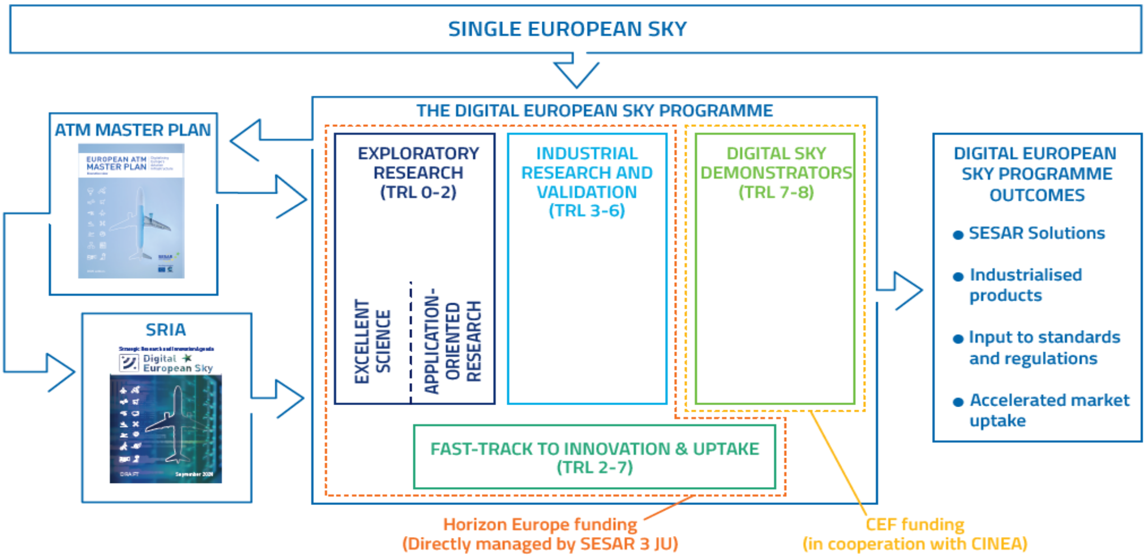

Figure 1: The SESAR innovation pipeline

The pipeline is designed to ensure that the SESAR solutions emerging from the development phase are not only thoroughly tested and refined but are also inherently "ready to deploy". The SESAR 3 JU drives both the definition and development phases, and assumes a pivotal role in the deployment phase. Through the Digital Sky Demonstrators (DSDs) and in close collaboration with the entities responsible for deployment, in particular the SESAR Deployment Manager, SESAR 3 JU contributes to a seamless transition from development to implementation, and for a large adoption across Europe.

The SESAR 3 JU will provide financial support, mainly in the form of grants, to R&I indirect actions, selected following open, transparent and competitive calls ensuring their openness for newcomers[4].

Figure 2 provides an overview of the high-level planning and calls sequence of the DES programme for 2021–2030. The calls sequence is taking into consideration the need to ensure the R&I pipeline in feeding the new calls with previous calls' results.

[3] Within the DES, Digital Sky Demonstrators are subject to a specific working arrangement. In this arrangement, the SESAR 3 JU ensures the strategic orientation of the projects and provides technical advice to the European Commission, in coordination with the European Climate, Infrastructure and Environment Executive Agency (CINEA), which manages the calls for proposals and the resulting grants.

[4] As defined in Article 5.2(a) of the Single Basic Act.

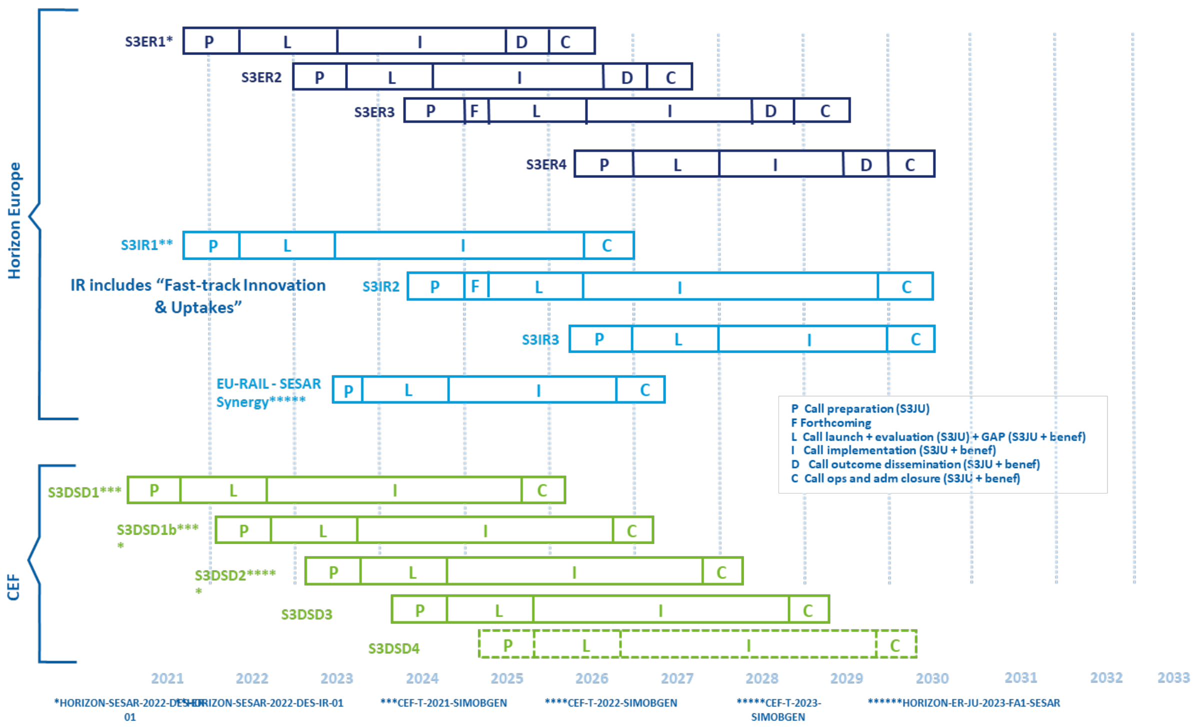

Figure 2: The Digital European Sky calls sequence

In addition to the operational activities, SESAR 3 JU incorporates transversal activities such as master planning, performance management and preparation for standardisation. As part of the SESAR 3 JU programme management, these transversal activities guarantee coherence among individual projects, thereby contributing to the overall cohesion of the DES program. This significantly increases the programme's capacity to deliver solutions that closely align with the R&I agenda set in the SRIA and the ambitions outlined in the European ATM Master Plan.

Chapter II – Bi-Annual work programme for 2024-2025

1 Executive Summary

In 2024-2025, the SESAR 3 JU is committed to advancing the DES programme in order to achieve the ambitions set out in the European ATM Master Plan. Building on the success of the implementation of the BAWP 2022-2023, the SESAR 3 JU proposes a streamlined BAWP 2024-2025, focusing on key priorities and activities for optimal success. The JU will concentrate on delivering 10 operational objectives that capture the main achievements expected at operational and organisational levels during these two years.

Operational activities

In 2024, the SESAR 3 JU plans to update the European ATM Master Plan. This revision will influence the R&I priorities guiding the activities of the JU in the subsequent years. Following the adoption of the updated ATM Master Plan, the SESAR 3 JU will begin preparing a proposal to the Commission outlining the content of a new Common Project or alternative regulatory measures, aligned with the deployment priorities of the updated ATM Master Plan.

SESAR 3 JU will closely monitor the implementation of the first wave of projects awarded under the ER1 and IR1 calls to ensure that they deliver as planned. In 2024, the JU will further expand its portfolio by selecting a new wave of research projects awarded under the ER2 call, while preparing the publication of the ER3 and IR2 calls planned for January 2025. The joint call with Europe's Rail JU (EU-Rail), initiated in 2023 and concluding in February 2024, will receive continued support from the SESAR 3 JU, providing technical expertise during the implementation phase.

To facilitate and accelerate market uptake of key SESAR solutions, and provide a platform for a critical mass of "early movers", the SESAR 3 JU will provide technical expertise and support to the DSDs through the projects already launched under CEF calls (DSD1a and DSD1b), and the upcoming one in 2024 (DSD2).

In order to ensure the proper representation of the entire ATM value chain, the SESAR 3 JU will conduct a membership expansion by welcoming new associated partners that add value to the partnership in fulfilling its objectives.

Finaly, the final report of the SESAR 2020 programme will provide a comprehensive view of the results.

Support to operations

Throughout 2024 and 2025, the SESAR 3 JU will carry out a range of corporate and back-end services to support the aforementioned operational activities.

SESAR 3 JU will strive for efficiency as an agile organisation and an attractive employer. Strategic initiatives for seamless HR and legal operations, including talent management, professional development and legal compliance, will be implemented, with a proactive approach maintained to foster a compliant and secure work environment. Advancements in digital capacity, including continuous collaboration of ICT services with EUROCONTROL and the European Commission, will ensure security and efficiency in operations, leveraging economies of scale.

In line with its Communication Strategy, activities will aim at promoting the DES vision and the role of the SESAR 3 JU through participation to and organisation of major events and conferences, including the Annual SESAR 3 JU Conferences, and the SESAR Innovation Days. Publications such as reports, catalogues and brochures will aim to raise awareness on the solutions developed, showcase results, and demonstrate the added value of the partnership and the programme. This collaborative effort will extend to engagement with international partners leading up to the 42nd ICAO Assembly in 2025.

2 Operational activities of the SESAR 3 Joint Undertaking for 2024–2025

2.1 Objectives, indicators and related activities per Strategic Area of Operation

Through its BAWP 2024-2025, the SESAR 3 JU delivers on the general and specific objectives set in the Single Basic Act[5]. In addition, the MAWP[6] defines five Strategic Areas of Operations (SAO) that frame the operations of the SESAR 3 JU and the delivery of the DES programme activities. The section below provides a description of the activities that will be undertaken under each SAO.

These activities deliver on the 10 overarching operational objectives that capture the main goals of the SESAR 3 JU over the two years of operation[7].

The Table below presents these 10 operational objectives, with their key performance indicators and targets for the years 2024 and 2025[8]. It also highlights their links with the general and specific objectives included in the Single Basic Act and with the five SAO and their related activities.

No	Operational Objectives 2024-2025	Key Performance Indicators	Target for 2024	Target for 2025	Related objectives in the Single Basic Act (Art. 142)	Related SAO/Activities
1	**Update European ATM Master Plan to make Europe the most efficient and environmentally friendly sky to fly in the world**	Adoption of the updated European ATM Master Plan	100%	n.a	All	SAO 1: Provide strategic steering to the DES programme

[5] The general objectives of the SESAR 3 JU are defined in Articles 4, 5 (general objectives common to all JUs), and 142(1) of the Single Basic Act, while its specific objectives are defined in the Article 142(2) of the same act.

[6] In section 2.4 of the MAWP.

[7] The 10 operational objectives have been developed in full alignment with its legal mandate, its ultimate goals as per the MAWP and in alignment with the European ATM Master Plan and the SRIA. The operational objectives follow the SMART principle to ensure a clear road map and efficient monitoring by a set of RACER key performance indicators.

[8] Some targets have been updated in the second amended version of the BAWP 2024-2025 to reflect the evolution of the activities in 2024.

No	Operational Objectives 2024-2025	Key Performance Indicators	Target for 2024	Target for 2025	Related objectives in the Single Basic Act (Art. 142)	Related SAO/Activities
2	**Prepare a proposal for the content of a new Common Project or alternative regulatory measures leveraging the outcome of SESAR 2020 and aligned with the deployment priorities defined in the new European ATM Master Plan**	Deliver proposal for a new Common Project (CP) to DG MOVE	n.a	50%.[9]	All expect 2 a-c	SAO 4: Facilitate an accelerated market uptake of SESAR Solutions
3	**Launch new wave of ER/IR calls aligned with the priorities defined in the new European ATM Master Plan**	Launch a new wave of ER-IR projects aligned with the priorities identified in the European ATM Master Plan	n.a	100%	All expect 1 c and 2 d	SAO 2: Deliver exploratory research SAO 3: Deliver industrial research and validation
4	**Continue to build critical mass of early movers to accelerate market deployment of Phase C**	Provide technical specifications in view of DSD3 call	100%	n.a	1 c and 2 d	SAO 4: Facilitate an accelerated market uptake of SESAR Solutions
		Provide technical specifications in view of DSD4 call	n.a	100%		
		Consolidate results from first DSD1a call	n.a	100%		
5	**Complete targeted membership expansion**	Complete selection process of associated members	100%	n.a	All	All
6	**Promote and develop synergies in high priority areas linked to the mission of the JU**	Develop a common roadmap with content and timelines with Clean Aviation	50%	100%	1 c and 2 d	SAO 4: Facilitate an accelerated market uptake of SESAR Solutions

[9] The 50% target of this objective reflects the fact that the activities will start in 2025 and continue in 2026.

No	Operational Objectives 2024-2025	Key Performance Indicators	Target for 2024	Target for 2025	Related objectives in the Single Basic Act (Art. 142)	Related SAO/Activities
		Sign Memorandum of Cooperation (MoC) with EUSPA	100%	n.a		
		Develop together with the SRG a plan to capture synergies with national programmes	50%	100%		
7	**Secure a positive mid-term review outcome**	Positive outcome of the mid-term review	n.a	100%	All	All
8	**Ensure delivery of first wave of awarded projects**	Ensure ER projects delivery through project reviews and deliver strategic development monitoring report	100%	100%	1 a and b, 2 b	SAO 2: Deliver exploratory research SAO 3: Deliver industrial research and validation
		Ensure IR projects delivery through project reviews and deliver strategic development monitoring report	100%	100%		
9	**Ensure global interoperability through active engagement with international partners in particular towards the 42nd ICAO Assembly in 2025**	Alignment between the GANP and the updated European ATM Master Plan	n.a	100%	All	SAO 5: Deliver SESAR outreach (cooperation, synergies and cross-cutting themes and activities)
10	**Transformation of our organisation towards a greener and more digital place to work**	Implementation rate of action plan to introduce EMAS in cooperation with EUROCONTROL	30%	60%.[10]	All	All

[10] The 60% target reflects the fact that this objective will continue in 2026.

No	Operational Objectives 2024-2025	Key Performance Indicators	Target for 2024	Target for 2025	Related objectives in the Single Basic Act (Art. 142)	Related SAO/Activities
		Implementation rate of action plan to digitalise the organisation	50%	100%		

2.1.1 Strategic area of operation 1: Provide strategic steering to the Digital European Sky programme

For the years 2024-2025, the focus will be on the delivery of an update of the European ATM Master Plan. This proposal will be aligned with the 8 success criteria defined by the GB for the update campaign. The two projects AMPLE3 and PEARL, awarded under the call HORIZON-SESAR-2022-DES-IR-01 in 2023, with a total grant amount of € 3.613.999,61, will contribute to these activities.

To help steer the future R&I efforts of the SESAR 3 JU, an amendment of the BAWP 2024-2025 will be prepared to reflect the new European ATM Master Plan priorities planned for adoption in December 2024.

Furthermore, the SESAR 3 JU aims to complete its targeted membership expansion.

2.1.2 Strategic area of operation 2: Deliver exploratory research

The activities undertaken under this SAO, which aim at bringing out innovative, unconventional and breakthrough solutions, will contribute towards meeting the operational objectives to ensure alignment with the priorities defined in the new European ATM Master Plan, the delivery of the first wave of awarded projects and the launch of the new wave of ER projects aligned with the priorities defined in the new European ATM Master Plan. The subsections below summarise the planned exploratory activities per call.

2.1.2.1 *DES ER 1 call (HORIZON-SESAR-2022-DES-ER-01)*

A total of 18 grants have been awarded amounting to a total of € 22.287.315. Respectively eleven and six projects address work areas (WA) 1 and 2, while the project Engage 2 is providing support to the SESAR 3 JU in the continuation of the knowledge transfer network[11]. During 2024-2025, the SESAR 3 JU will closely monitor these projects to ensure that they develop their research activities in compliance with the signed grant agreements in particular in terms of timing and deliverables at expected maturity and readiness level. The projects should deliver their research results by mid-2025 and ensure their dissemination during the second semester of 2025. The 18 projects are summarised in Figure 3 per flagship.

[11] More information on SESAR 3 JU's Knowledge Transfer Network and its activities aimed at fostering closer ties between academia and industry and prepare the future aviation workforce is available on the SESAR 3 JU website: https://www.sesarju.eu/news/engage-2-fostering-knowledge-transfer-air-traffic-management-research-and-innovation

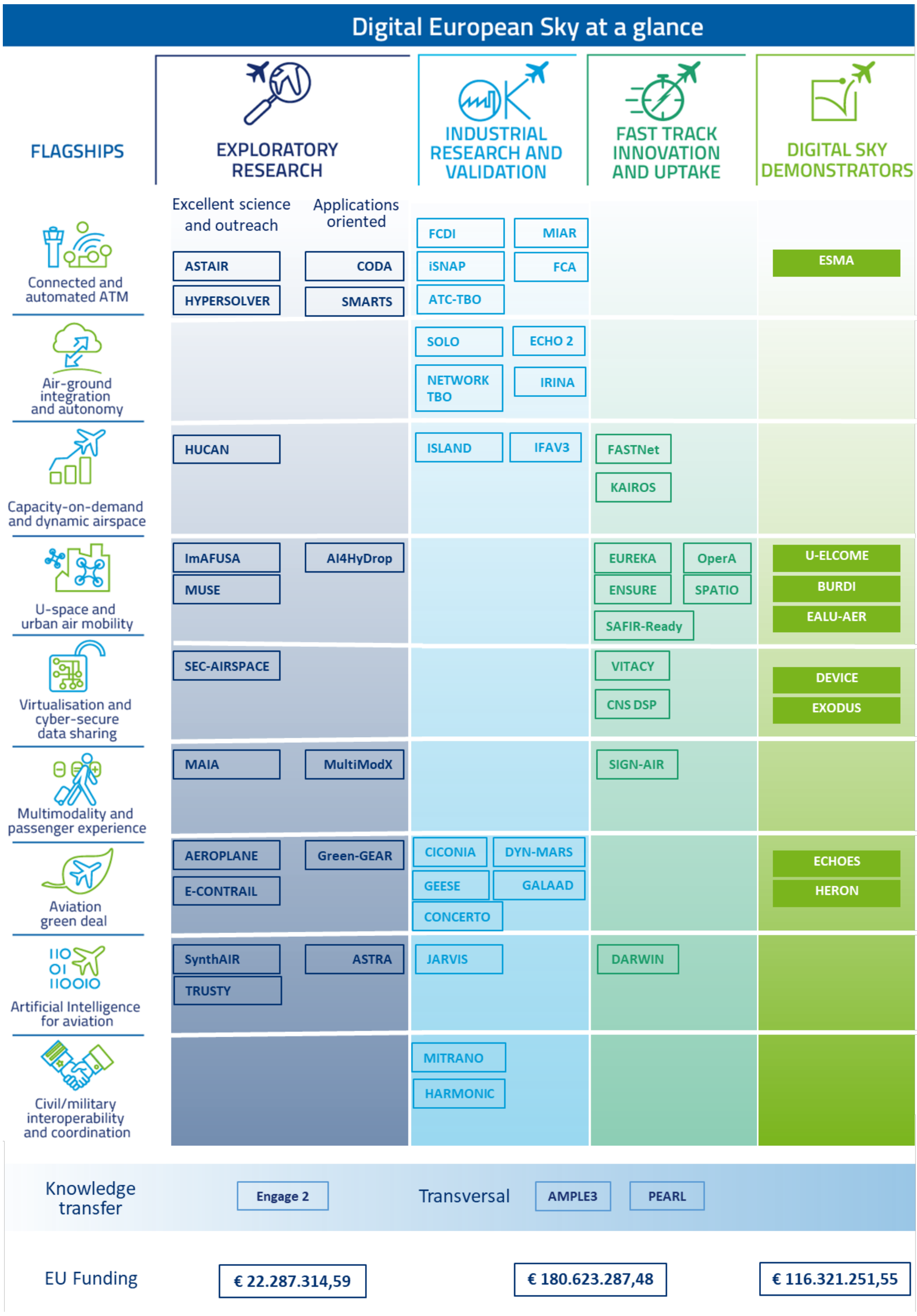

Figure 3: The DES portfolio in December 2023

2.1.2.2 *DES ER 2 call (HORIZON-SESAR-2023-DES-ER-02)*

The ER2 call content was elaborated by considering three key aspects: analysing the BAWP content already covered by ER1 call proposals, taking into account findings from the previous 40 SESAR 2020 ER4 projects, and identifying new elements that required additional research activities, in alignment with the SRIA. The call deadline for the submission of proposals was set for November 2023 and will be followed by the evaluation phase of the received proposals. In February 2024, the SESAR 3 JU intends to finalise the evaluation with the award of the selected proposals, with the aim of signing the grant agreements by mid-July 2024. This timeframe would enable the new ER2 projects to start their execution in Q3 2024. The projects should deliver their research results early 2026.

2.1.2.3 *Scope and budget of the ER1 and ER2 calls*

The following figure presents the coverage of the flagships per call, the EU funding for ER1 and the indicative budget for ER2.

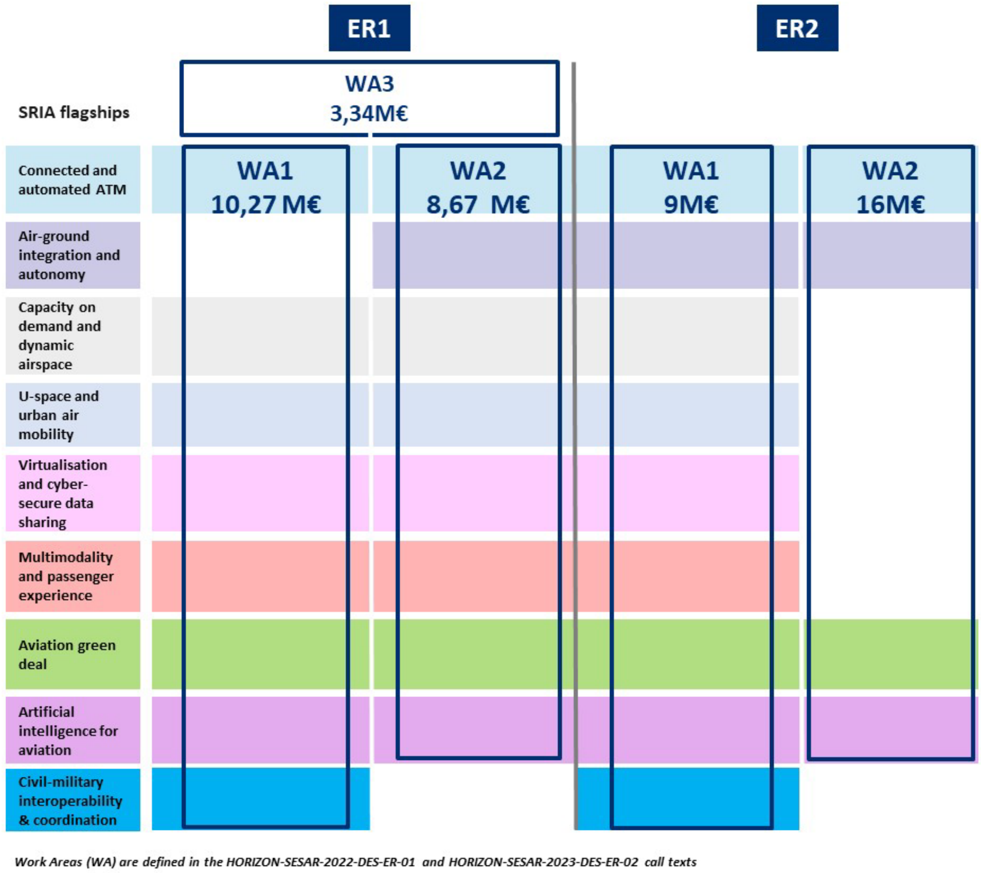

Figure 4: Coverage of the SRIA flagships through the first set of the exploratory research calls for proposals of the DES

2.1.2.4 *DES ER 3 call (HORIZON-SESAR-2025-DES-ER-03)*

In 2024, the SESAR 3 JU will prepare the third DES exploratory research call (HORIZON-SESAR-2025-DES-ER-03). The technical specifications should be adopted by the GB in December 2024 in conjunction with the new European ATM Master Plan. The ER3 call will be published in January 2025 and opened in April 2025, leaving additional time for the potential participants and consortia to prepare. The call deadline is tentatively set in September 2025. Following the evaluation and the award of the selected proposals, the grant preparation phase should be opened in January 2026 leading to getting all grants signed by May 2026. The projects would then start their research activities in the second half of 2026.

The indicative budget of the call is € 24.000.000.

2.1.3 Strategic area of operation 3: Deliver industrial research and validation

The main objective of the activities under this strategic area of operation is to deliver SESAR solutions that are based on the European ATM Master Plan and identified in the MAWP. The activities of this

SAO support the successful achievement of a new wave of IR projects aligned with the priorities defined in the new European ATM Master Plan, ensure IR projects delivery through project reviews and deliver the strategic development monitoring report, and the SESAR 3 JU transversal operational objectives. For the years 2024-2025, the DES industrial research and validation activities will facilitate the migration of ideas from exploratory research into applied research and towards the pre-industrial development stage, validation, digital sky demonstrators and final preparation for deployment. This will be achieved through the projects funded under the three calls for proposals, DES IR1, EU-RAIL – SESAR Synergy and DES IR2, presented below.

2.1.3.1 *DES IR1 call (HORIZON-SESAR-2022-DES-IR-01)*

A total of 32 grants have been signed in Q3 2023 with a total granted amount of € 181.345.600. In particular, two projects were awarded in WA1; five in WA2; nine in WA3; five in WA4, six in WA5 and five in WA6. The SESAR 3 JU will closely monitor these projects to ensure that they will develop their SESAR solutions in compliance with the signed grant agreements in particular in terms of timing and deliverables at expected maturity and readiness level, by the end of 2026. The 32 projects are summarised in Figure 3 per flagship.

2.1.3.2 *HORIZON-ER-JU-2023-FA1-SESAR*

In 2024-2025, the SESAR 3 JU will continue contributing to the joint call with the Europe's Rail JU, which was launched in Q4 2023 with a call closure set at the beginning of February 2024. The call, with a total budget of € 5.000.000 and a fairly shared contribution between the two JUs (€ 3.000.000 for the SESAR 3 JU), will be administratively managed by the Europe's Rail JU. In particular during 2024-2025, the SESAR 3 JU will provide technical expertise to the evaluation and selection of proposals and in the monitoring of the projects. The aim is to ensure the delivery of SESAR solutions at the required SESAR 3 JU quality and maturity levels.

Following the evaluation and the award of the selected proposals, the grant preparation phase should be opened in April 2024 leading to grant signature by Q3 2024. The projects would then start their activities by September 2024 in order to deliver the SESAR solutions at TRL 6 maturity level by Q3 2027, following the fast-track approach.

2.1.3.3 *Scope and budget of the IR1 and the joint EU-RAIL – SESAR Synergy calls*

The following figure presents the coverage of the flagships per call, the EU funding for IR1 and the indicative budget for the joint EU-RAIL – SESAR Synergy call.

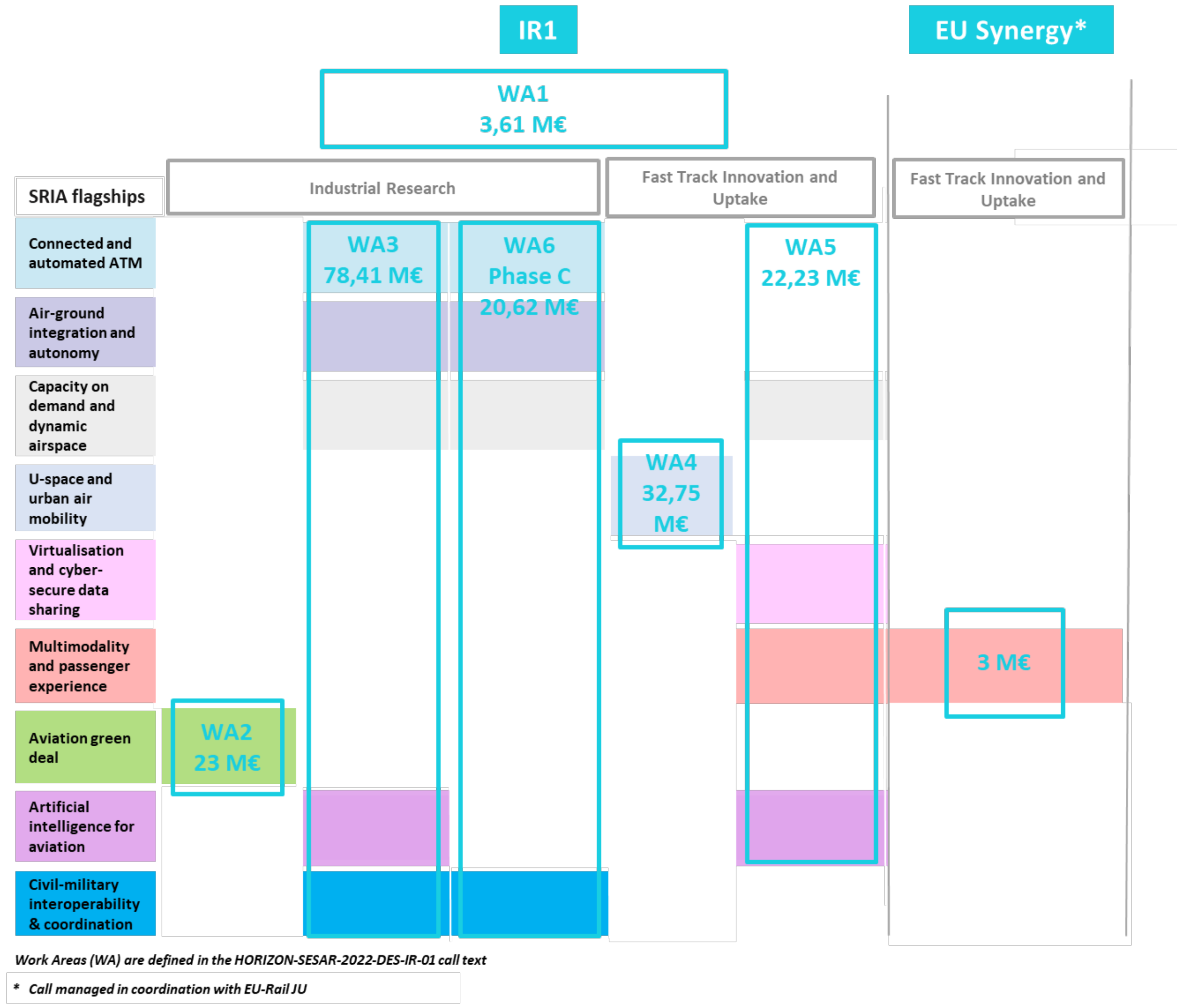

Figure 5: Coverage of the SRIA flagships through the first set of calls for proposals for industrial research and validation including the EU-RAIL-SESAR Synergy call

2.1.3.4 *DES IR 2 call (HORIZON-SESAR-2025-DES-IR-02)*

In 2024, the SESAR 3 JU will prepare the second DES industrial research call (HORIZON-SESAR-2025-DES-IR-02). The technical specifications are expected to be adopted by the GB in December 2024 in conjunction with the adoption of the updated European ATM Master Plan. The IR2 call will be published in January 2025 and opened in April 2025, leaving additional time for the potential participants and consortia to prepare. The call deadline is tentatively set for September 2025. Following the evaluation and the award of the selected proposals, the grant preparation phase should be open in January 2026, leading to the signature of grant agreements by May 2026 and the beginning of the research activities in the second half of 2026.

The indicative budget of the call is € 230.000.000.

2.1.4 Strategic area of operation 4: Facilitate an accelerated market uptake of SESAR Solutions

The activities under this strategic area of operation will support three main operational objectives for the years 2024 and 2025. First to start the preparation of a proposal for the content of a new Common Project (CP) or alternative regulatory measures leveraging the outcome of SESAR 2020 and aligned with the deployment priorities defined in the new European ATM Master Plan. Second, to continue to build critical mass of early movers to accelerate market deployment of Phase C. And third, to promote and develop synergies in high priority areas linked to the mission of the JU.

This will be achieved mainly by providing technical support to the Digital Sky Demonstrators through the projects under CEF calls, CEF-T-2021-SIMOBGEN and CEF-T-2022-SIMOBGEN, contractually managed by CINEA. The SESAR 3 JU will continue to provide technical expertise during the execution phase.

More specifically, in 2024-2025, during the implementation phase of the DSD calls, the SESAR 3 JU will aim at ensuring that the demonstrators will take place in live operational environments and put to the test the concepts, services, technologies and standards necessary to deliver the DES. To that end, technical projects reviews will be run in 2024 and 2025 to assess the progress made by the projects and take corrective actions if needed to ensure moving towards TRL 8. During the projects' review, particular attention will be paid to the connection of the projects to the standardisation, regulatory and deployment activities, notably by involving standardisation bodies and manufacturers. It has been shown that early engagement with the regulator during the demonstration process can significantly de-risk subsequent issues related to regulatory needs, approvals, safety assessments etc. for the SESAR solutions under scope.

Furthermore, the SESAR 3 JU will also strengthen coordination with the European entities responsible for the execution of deployment activities, mainly the SESAR Deployment Manager (SDM). The aim is to monitor and de-risk at technical level the roll out of the strategic deployment objectives defined in European ATM Master Plan and accelerate the market uptake of SESAR solutions.

DSDs being the key component in the facilitation of the deployment of SESAR solutions and a priority for the years 2024 onwards, the SESAR 3 JU is committed to provide input to the Commission for future CEF calls in 2024 and 2025 (DSD3 and DSD4).

2.1.4.1 *DSD call CEF-T-2021-SIMOBGEN (DSD1a)*

Five projects, with a combined grant amount of € 47.561.535 are currently in the implementation phase. Three projects address the U-space & Urban Air Mobility flagship (projects BURDI, EALU- AER and U-ELCOME) and two projects address the Aviation Green Deal flagship (projects ECHOES and HERON). These five projects are summarised in Figure 3 per flagship.

The DSD1a projects will be concluded by a TRL 8 exit maturity gate during Q3 2025.

2.1.4.2 *DSD call CEF-T-2022-SIMOBGEN (DSD1b)*

Three projects, with a combined grant amount of € 68.759.717 were awarded in 2023. Two projects address the Virtualisation and cyber-secure data sharing flagship (projects DEVICE and EXODUS), and one project addresses the Connected and automated ATM area flagship (project ESMA). These three projects are summarised in Figure 3 per flagship.

In 2024-2025 the SESAR 3 JU will closely monitor the execution of these demonstration activities that will be concluded by a TRL 8 exit maturity gate during Q3 2026.

2.1.4.3 *DSD call CEF-T-2023-SIMOBGEN (DSD2)*

A third call for proposals for DSDs, DSD2 (CEF-T-2023 SIMOBGEN), was launched in September 2023. The call deadline is set on 30 January 2024.

Following the CEF decision process, the grant preparation phase will be opened in June 2024 leading to the signature of the grant agreements by October 2024. The SESAR 3 JU will closely monitor the execution of the projects' demonstration activities in close coordination with CINEA. The projects will be concluded by a TRL 8 exit maturity gate during Q3 2027.

2.1.4.4 *Scope and budget of the DSD1a, DSD1b and DSD2 calls*

The following figure presents the coverage of the flagships per call and the CEF funding for DSD1a and DSD1b.

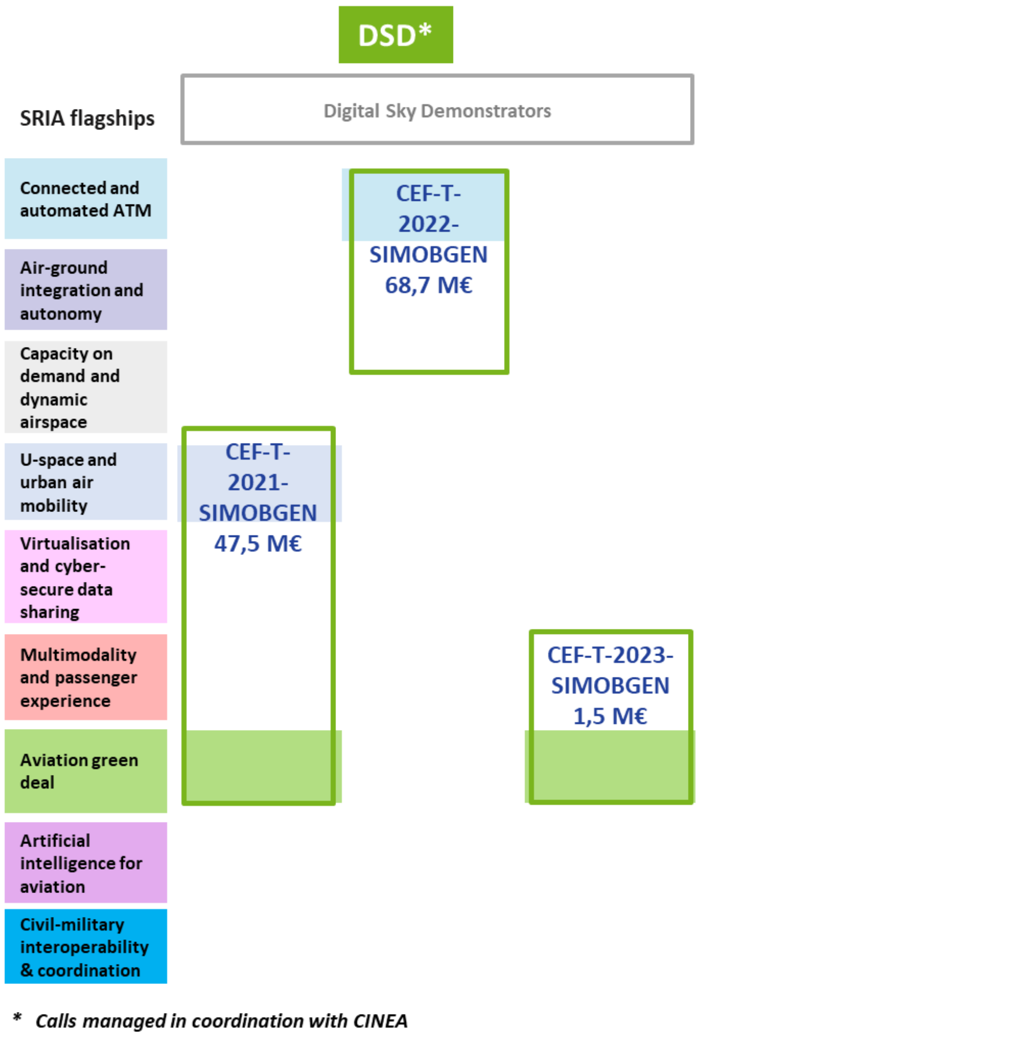

Figure 6: Coverage of the SRIA flagships through the calls for proposals of the DSDs

2.1.5 Strategic area of operation 5: Deliver SESAR outreach (cooperation, synergies and cross-cutting themes and activities)

For the years 2024-2025, the activities under this strategic area of operation will support the main operational objective of ensuring global interoperability through active engagement with international partners in particular towards the 42nd ICAO Assembly in 2025.

In addition, while all SESAR 2020 projects have been closed in 2023, in 2024, the SESAR 3 JU will publish a final report on the SESAR 2020 programme providing a comprehensive view of the results. In 2024, final audit activities will take place and the members other than the EU and EUROCONTROL of the predecessor JU (SESAR JU) will pay their last contribution (for more details on the administrative closure of the programme see section 3.1).

2.1.5.1 *Synergies*

The Single Basic Act requires the SESAR 3 JU to "*develop close synergies with other Horizon Europe initiatives and other Union programmes and funding instruments, particularly with those supporting the deployment of innovative solutions, education and regional development, in order to increase economic and social cohesion and reduce imbalances*." The Single Basic Act goes on to say that the joint undertakings should establish dialogue with Member States, particularly in the content of synergies, "*to ensure the alignment of efforts and activities at national, regional, Union and European level to create more impact*."

While the SESAR 3 JU was already successful in cooperating with the Connecting Europe Facility and Europe's Rail JU (see previous sections), it plans to implement a range of further synergy activities over the course of 2024/2025, drawing on the following toolbox of potential instruments:

- **Joint calls, cross-referencing**, e.g. publishing jointly funded calls, cross referencing relevant topics from the work programme of other entities, benefiting from complementary funding sources.
- **Coordination between governance structures**, e.g. presenting at board meetings of the other partnerships and initiatives.
- **Project clusters**, e.g. fostering interaction, exchange of data and deliverables, involvement in their respective activities where/if relevant (aka portfolio building).
- **Knowledge exchange**, and e.g. sharing experiences and not 'reinvent the wheel'.
- **Formal commitments**, e.g. MoU or formal Cooperation agreements on specific activities (e.g. joint calls, joint procurements).
- **Visibility promotion**, e.g. featuring the work of relevant initiatives in respective communications channels.
- **Events on common priorities/themes,** e.g. workshops, common stands at exhibitions.

The following entities have been identified as priorities for establishing additional synergies over the course of 2024-2025:

Horizon Europe

- **Clean Aviation Joint Undertaking**
  The SESAR 3 JU will develop a common roadmap with content and timelines with Clean Aviation for consideration also in the update of the European ATM Master Plan.
- **European Union Agency for the Space Programme (EUSPA)**
  Using as a basis the MoC with EUSPA expected to be signed in 2024, the SESAR 3 JU will foster synergies with EUSPA for the advancement of space-based solutions for European air traffic management, including U-space.

- **Projects funded under Cluster 5 calls**
  The SESAR 3 JU will identify projects outside the DES programme that are funded by Horizon Europe and that address aspects of air traffic management. The aim is to facilitate synergies with these projects in the future.

Other EU-level programmes, funding instruments, initiatives

- **Innovation Fund (CINEA)**
  The SESAR 3 JU will explore with the European Commission/CINEA the scope for using the Innovation Fund for implementation of air traffic management projects.

- **European Defence Fund (via European Defence Agency (EDA))**
  The SESAR 3 JU will build on its established cooperation with the EDA to explore opportunities for synergies specifically related to funds made available to EDA via the European Defence Fund.

National

- **Member States (via States' Representatives Group)**
  The SESAR 3 JU will continue to work closely with the members of its SRG to identify potential synergies between the JU's actions and national or regional initiatives and policies.

2.1.5.2 *Stakeholder engagement*

The SESAR 3 JU's outreach work during 2024–2025 aims to secure the involvement of stakeholders in the SESAR 3 JU's R&I activities, including in support of validating SESAR solutions, as well as to ensure close coordination and, where appropriate, alignment with activities delivered by other organisations, which are of strategic importance to the success of the SESAR project, such as standardisation and deployment.

2.1.5.2.1 Institutional stakeholders

The SESAR 3 JU will maintain close relations with its key institutional stakeholders to ensure that its activities are aligned with and take into account developments in the EU's policy on ATM. It will also establish appropriate cooperation and coordination with the following organisations, including through formal cooperative arrangements when appropriate.

European Union Aviation Safety Agency (EASA). The service-level agreement (SLA) between the SESAR 3 JU and EASA secures close collaboration between both organisations to ensure an early exchange of knowledge on new technologies, thereby facilitating the certification and regulatory process of resulting products and services, and ultimately accelerating market uptake of SESAR solutions. The arrangements allow a close coordination between the SESAR 3 JU and EASA to enable timely development by EASA of regulatory measures that fall under the EASA basic regulation and the relevant implementing rules. Moreover, EASA is closely involved in a number of ongoing projects, and particular attention will be paid to the early engagement of EASA in the new ER and IR projects (safety, regulatory, standardisation and certification aspects where appropriate).

European Defence Agency (EDA). Through its MoC with the EDA, the SESAR 3 JU will secure support and buy-in from the military community (in their roles as ANSPs, airport operators, airspace users and regulators) in relation to SESAR 3 JU activities. In particular, areas of common interest include the European ATM Master Plan, space-based systems, the integration of unmanned aerial system (UAS), cybersecurity and the development of aviation/ATM standards.

EU Agency for the Space Programme (EUSPA). Through the MoC with EUSPA, the SESAR 3 JU will seek coordination and joint promotion of R&I activities where satellite technologies are involved, promotion of the global navigation satellite system (GNSS) solutions to airspace users, and support to the development of innovative solutions for ATM and U-space leveraging space services.

European Space Agency (ESA). The SESAR 3 JU will explore establishing a MoC with ESA to secure strategic cooperation to coordinate roadmaps, specifically in relation to the integrated communications, navigation and surveillance (CNS) strategy defined in the European ATM Master Plan, defining the role of satellite systems (communications, navigation, surveillance and spectrum) as an element of importance for the future enabling CNS infrastructure for ATM.

2.1.5.2.2 Industry stakeholders

The SESAR 3 JU will foster strong ties with key European stakeholder groups, including, in particular, the following:

SESAR Deployment Manager (SDM). Through its MoU with the SDM, the SESAR 3 JU will ensure coherence between the strategies and programmes of the two organisations and the necessary connections between SESAR research, development, innovation and validation activities and the deployment of SESAR solutions. The SESAR 3 JU and SDM will work together to ensure a seamless SESAR lifecycle with all the relevant partners, from R&D to deployment, in their respective areas of involvement, with the goal of improving coordination, planning and implementation of SESAR and accelerating deployment.

Alliance for Zero-Emission Aviation (AZEA). The SESAR 3 JU will participate in the Alliance as a member and contribute in particular to the activities of the Working Group dealing with the integration of electric and hydrogen-powered aircraft into the European network.

Standardisation bodies. The contribution of the SESAR 3 JU to the development of European standards is of key importance in helping accelerate market uptake of SESAR solutions. The SESAR 3 JU will continue to participate actively in the EUROCAE Council and the Technical Advisory Committee, as well as the European ATM Standards Coordination Group and the European UAS Standards Coordination Group. The aim is to secure close collaboration between the SESAR 3 JU members and ensure the availability of SESAR material in support of standardisation. SESAR material is also to be used for the effective development of standards to support European regulation, international standardisation and the delivery of the European ATM Master Plan and the ICAO Global Air Navigation Plan (GANP).

Civil Air navigation service providers (ANSPs). The SESAR 3 JU will work closely with the Civil Air Navigation Services Organisation (CANSO) to ensure the broadest possible awareness of SESAR 3 JU activities and to secure engagement and buy-in from ANSPs, including those outside the membership of the SESAR 3 JU. In particular the SESAR 3 JU will participate in CANSO’s Complete Air Traffic System (CATS) initiative which aims to design and deliver the next generation air transport system on the basis of an agreed roadmap developed through a highly collaborative process involving a wide range of ATM stakeholders globally.

Professional staff organisations. The SESAR 3 JU will implement the arrangements to secure the support of different professional staff organisations to provide operational and technical knowledge of direct relevance to the successful delivery of SESAR results and solutions. This will also serve to enhance the buy-in of end users in relation to ATM modernisation and SESAR solutions.

Civil Airspace users. The SESAR 3 JU will continue to reach out to airspace user organisations to secure awareness of and commitment to its work and activities, including implementing arrangements to secure, where appropriate, their technical expertise and advice for project-related activities.

European airports. The SESAR 3 JU will work closely with European airports and the Airports Council International on airport-related activities in its work programme to secure airports' active engagement and to raise awareness of SESAR among airport partners, including through events.

New entrants. The SESAR 3 JU will approach new innovative airspace users and organisations in the field of unmanned traffic management / U-space, UASs and high-altitude operation (HAO) based on relevant EU strategies and on a case-by-case basis to find the most efficient mechanism of cooperation for the benefit of SESAR 3 JU tasks and activities. In particular, the SESAR 3 JU will support the European Network of U-space Stakeholders, set up by the European Commission to promote stakeholder engagement in Innovative Air Mobility (IAM) deployment.

Small and medium-sized enterprises (SMEs) and start-ups. The SESAR 3 JU will seek opportunities to reach out to SMEs and start-ups to associate them with its activities and thereby help stimulate and scale up the R&I network. This will include exploring the possibilities to put in place cooperative arrangements to inform and involve this community, for example with the European Aerospace Cluster Partnership sponsored by the European Commission and the European Start-Up Prize for Mobility under the patronage of the European Parliament.

Research Associations. The SESAR 3 JU will continue its engagement with key research groupings, including the Advisory Council for Aviation Research and Innovation (ACARE) to establish a wider aviation view on progress related to their "Fly the Green Deal" vision, the European Aeronautics Science Network (EASN), through events of shared interest, to ensure ATM obtains appropriate visibility, and the Association of Scientific Development of ATM in Europe (ASDA), by improving information flow to/from their members.

2.1.5.3 *Cooperation with non-EU countries and international organisations*

Pursuant to its strategy for cooperation with third countries and international organisations, the SESAR 3 JU will continue during 2024–2025 to engage actively with key international partners in support of global interoperability and harmonisation. It will do so in close coordination with the European Commission to ensure consistency and alignment with the EU's broader aviation strategy, in particular its external affairs dimension.

With the entry into force of the association of the UK to Horizon Europe, from 1 January 2024, UK entities will be able to fully participate on the same terms as entities from other associated countries.

At the global level, in relation to ICAO, the SESAR 3 JU will maintain active participation and collaboration under the leadership of the European Commission. This will include participation in the preparation of Europe's contributions to the 42nd ICAO Assembly in 2025. The SESAR 3 JU will also participate in the ICAO GANP Study Group, which oversees the future evolution of the ICAO GANP, and ICAO's new Advanced Air Mobility Study Group. The alignment between the ICAO GANP, the European ATM Master Plan and the DES programme is essential to de-risk development towards deployment.

The SESAR 3 JU will maintain its close collaboration with the US Federal Aviation Administration (FAA) and its next generation air transportation system (NextGen) programme under the umbrella of the EU–US MoC on ATM modernisation, civil aviation research and development, and global interoperability. The SESAR JU-NextGen cooperation will focus on four work areas: integration of new entrants (higher airspace operations, urban air mobility and small UAS), evolution of performance-based technologies (integrated CNS, TBO and standards), advancing innovation into ATM (cyber security, human factors, and exploratory research), and coordination in relation to ICAO.

The existing cooperative arrangements with other international partners covering the ATM domain, whether of the SESAR 3 JU or at the level of the European Commission or the EU, will be maintained and, where appropriate, further enhanced during 2024–2025 as SESAR solutions evolve and are deployed. This includes arrangements with Georgia, Japan, Qatar and Singapore. The SESAR 3 JU will also work closely with the European Commission and other SESAR 3 JU members to identify and leverage opportunities to extend and deepen international collaboration. Priorities will be set in line with the EU's external aviation policy, and will include the EU's neighbourhood countries as well as those third countries with whom the EU has, or is seeking to negotiate, a comprehensive air transport agreement. The SESAR 3 JU will also participate where relevant in activities including under the EU's technical cooperation projects with Latin America, North Asia, South Asia and South-East Asia. In doing so, the SESAR 3 JU will closely follow the policies of the EU and the needs of the Sustainable and Smart Mobility Strategy, EU aviation strategy and of the SES framework.

Due to the EU sanctions imposed on Russia and Belarus in response to the war of aggression against Ukraine, there is currently no appropriate context allowing the implementation of the actions foreseen in this programme with legal entities established in Russia, Belarus, or in non-government controlled territories of Ukraine.

2.2 Research and innovation priorities, challenges and expected impacts

The challenges facing the aviation sector are both longstanding and emerging. Most critically, the sector must significantly reduce its CO_2 emissions while managing an ever-growing volume of air traffic, which will continue to strain the capacity of the ATM system. Over the coming decade, the airspace will undergo dramatic changes, becoming more complex to manage with the introduction of new types of air vehicles, such as drones, air taxis, and high-altitude aircraft. By 2035, zero-emissions aircraft (e.g. hydrogen and electric) that operate differently from today's traditional aircraft will begin entering service. These transformations must be addressed in the context of increasingly severe weather caused by climate change and a shifting security and defence landscape in Europe, which not only poses additional security challenges but also reduced the available airspace by around 20%. In light of these challenges, the ATM system will need to become more scalable, resilient, and efficient, leveraging digitalization and automation to enable optimal flight trajectories across the network, anywhere and anytime.

Against this backdrop, the new European ATM Master Plan 2024 sets the vision and priorities to make Europe the most efficient and environmentally friendly sky to fly in the world by 2045. It also outlines the expected benefits (capacity, fuel, CO_2, punctuality, cost-efficiency) as well as what that means for Europe's economy and citizens. This vision is underpinned by the Digital European Sky, which leverages advanced digitalization, automation, and data-driven operations to optimize ATM while ensuring sustainability, safety, and security. The transition from today's ATM to tomorrow's Digital European Sky is divided into 4 overlapping phases (A to D) of development and deployment of essential operational changes covering ATM functionalities. The development of the solutions supporting Phase C, which started under SESAR 2020 programme, is expected to be completed by 2026, benefiting from results of projects launched under the IR1 call. The development of the solutions supporting Phase D has already started under IR1 and it will continue under the calls to be launched in 2025. The deployment of this final phase of the ATM Master Plan should be completed by 2045.

The ATM Master Plan identifies 12 strategic Development Priorities (DPs) which cover the prioritised actions needed to develop future ATM functionalities and roll out phase D.

IR	Strategic development priorities	
IR-01	Transformation to trajectory-based operations	Industrial research
IR-02	Transition towards high performance of air-ground connectivity (multilink)	
IR-03	Future en-route and TMA ground platforms	
IR-04	Future airport platform	
IR-05	Autonomy and digital assistants for the flight deck	
IR-06	U3 U-space advanced services, IAM and vertiports	
AR-01	Research to help shape the future regulatory framework for a Digital European Sky	Exploratory research
AR-02	Definition of U4 U-space full services	
AR-03	Integration of the next generation aircraft for zero/low emission aviation	
FR-01	ATM impact on climate change	
FR-02	Digital flight rules	
FR-03	Investigate quantum sensing and computing applied to ATM	

Figure 6a: Strategic development priorities as identified in the new ATM Master Plan

In 2025, the SESAR 3 JU will launch two calls for proposals targeting Exploratory research and Industrial research, both of which are aligned with the Development Priorities of the ATM Master Plan. These calls are integral to the SESAR innovation pipeline and are designed to push promising concepts and future potential solutions through the different maturity stages towards industrialisation and future deployment. These calls for proposals, which should deliver their solutions by the end of 2029, aim at significantly advancing the Development Priorities in relation to Phase D.

The **third Exploratory research call (ER3)** under the DES will focus on disruptive technologies and innovative concepts that are in the early stages of development. The primary aim is to explore new ideas, concepts, methods and technologies that will help define future development activities in ATM aligned with the long-term vision of the Digital European Sky for 2045. The ER3 call will address 5 of the 6 Development Priorities for Exploratory research through the following two Work Areas (WA) for Fundamental research (FR) and Applied research (AR):

- **WA1 Fundamental research:** comprises the exploratory research activities necessary to develop emerging concepts, technologies, and methods from TRL0 to the level of maturity required to feed the applied research (i.e., TRL1) conducted by the SESAR 3 JU. This WA addresses all three Development Priorities identified in the ATM Master Plan for Fundamental research, namely, "ATM impact on climate change", "Digital flight rules", and "Investigate quantum sensing and computing applied to ATM". In addition, it will also address any ATM/U-space Fundamental research area not covered by the ones mentioned previously.

- **WA2 Applied research:** comprises the exploratory research activities aiming to bridge the results of FR (i.e., TRL1) and the higher maturity ATM research performed as part of SESAR 3 JU industrial research activities (i.e., TRL2). This WA addresses two of the three Development Priorities identified in the ATM Master Plan for Applied research, namely "Research to help shape the future regulatory framework for a DES", and "Integration of the next generation aircraft for zero/low emission aviation". Applied research on U4 U-space services (Development Priority AR-2 "definition of U4 U-space services") is not included in this call. Since there are substantial on-going activities on U-space in ER2 projects (launched in 2024) and in the IR2 projects (to be launched this year), the SESAR 3 JU decided to consolidate R&I results on U3 before launching exploratory research activities on U4. Therefore, it is planned to include U4 in the future ER4 exploratory research call.

The **second industrial research call (IR2)** for proposals will focus on the development and maturation of ATM technologies and solutions enabling the Phase D of the ATM Master Plan in view of their industrialisation and subsequent deployment. This means usually TRL6, and TRL7 for the Fast-track[12]. The research will be concentrated on addressing all 6 Development Priorities under Industrial research outlined in the ATM Master Plan and significantly advance the corresponding development actions. Each Development Priority corresponds to a Work Area (WA):

- **WA1** covers Development Priority IR-01: Transformation to trajectory-based operations.

- **WA2** covers Development Priority IR-02: Transition towards high performance of air-ground connectivity (multilink).

- **WA3** covers Development Priority IR-03: Future en-route and TMA ground platforms.

- **WA4** covers Development Priority IR-04: Future airport platform.

- **WA5** covers Development Priority IR-05: Autonomy and digital assistants for the flight deck.

- **WA6** (Fast-track) covers Development Priority IR-06: U3 U-space advanced services, innovative air mobility (IAM) and vertiports.

In addition, **WA7** will cover the transversal activities in support of SESAR 3 JU and the R&I programme. The content of each WA is decomposed into one or more topics covering the R&I needs.

Further detail on these two calls for proposals, including on the conditions of the calls and relative management rules, can be found in Annex III.

[12] More information on the expected TRL levels for both Industrial research and Fast-track projects is provided in Annex III.

2.2.1 Calls for proposals

The following activities are scheduled to take place in 2024 and 2025 in relation to the calls for proposals as described in Chapter II, section 2.1:

- For exploratory research (SAO2):
  - Implement the HORIZON-SESAR-2022-DES-ER-01 call;
  - Launch and implement the HORIZON-SESAR-2023-DES-ER-02 call;
  - Prepare and launch the HORIZON-SESAR-2025-DES-ER-03 call.
- For industrial research and validation (SAO3):
  - Implement the HORIZON-SESAR-2022-DES-IR-01 call;
  - Launch and implement the HORIZON-ER-JU-2023-FA1-SESAR synergy call with the EU-Rail JU;
  - Prepare and launch the HORIZON-SESAR-2025-DES-IR-02 call.
- For the Digital Sky Demonstrators (SAO4) - contractually managed by CINEA:
  - Implement and close the DSD1a; CEF-T-2021-SIMOBGEN;
  - Implement the DSD1b; CEF-T-2022-SIMOBGEN;
  - Launch and implement the DSD2; CEF-T-2023-SIMOBGEN;
  - Prepare, launch and implement the DSD3; CEF-T-2024-SIMOBGEN;
  - Prepare and launch the DSD4; CEF-T-2025-SIMOBGEN.

2.3 Calls for tender and other actions

Annex II provides an overview of the planned calls for tender and other actions and the estimated budget.

3 Support to operations of the SESAR 3 Joint Undertaking for 2024-2025

3.1 Administrative closure of the SESAR 2020 Programme

From a financial point of view, 2024 is the year when the SESAR 2020 Members other than the EU and EUROCONTROL have to pay their seventh and last financial contribution to the running costs of the SESAR 3 JU. This last instalment will be calculated based on the cumulative amounts paid so far by each of these other Members against their final cumulative amount of declared and accepted IKOP to the SESAR 2020 Programme. All necessary financial adjustments will be done so that the obligation of the SESAR 2020 Membership Agreement are respected. In particular, the SESAR 3 JU will: 1) ensure that there is a fair repartition of the financial contribution paid by all member categories and 2) following the financial adjustments, prepare a decision by the GB on the use of any remaining amount.

The European Commission Common Audit Service (CAS) will perform ex-post audits, which may be started up to two years after the payment of the balance to SESAR 2020 projects. Besides, the European Commission has the right to trigger additional audits up to 5 years after the closure of the projects. The SESAR 3 JU will implement any actions deriving from such audits, which usually extend their effects to up to 2 years after the finalisation of the report; however, in certain cases, such effects might last longer.

3.2 Communication, dissemination and exploitation

3.2.1 Communication

Communication plays an integral role in building trust, securing buy-in and maintaining momentum for the SESAR 3 JU's R&I activities. It is also key for accelerating innovation and the implementation of SESAR solutions.

For full details of the planned approach, activities and channels, see the SESAR 3 JU communications strategy for 2022–2027[13].

In 2024 and 2025, the focus of the SESAR 3 JU's communication activities will be:

- promoting the added value of the partnership and the programme;
- promoting SESAR R&I activities in relation to key policy areas;
- showcasing results and solutions delivered by R&I projects;
- supporting members and projects regarding their obligations and commitments to communicate about projects within the framework of the partnership and programme.

The following table provides an overview of the major events and conferences in 2024 and 2025 in which the SESAR 3 JU expects to invest significant resources. However, it should be noted that various other conferences and events organised by the EU and by European and international stakeholders might require the SESAR 3 JU's participation through speakers, workshops or exhibition stands.

Event name	Location	Date	Organiser	Comments
SESAR Internal Gathering	Geneva	18 March 2024	SESAR 3 JU	A networking event with representatives from the membership and key stakeholders in order to provide an update on programme status, highlight achievements and promote upcoming activities.
Airspace World	Geneva	19-21 March 2024	CANSO	Exhibitions and/or workshops to promote the SESAR 3 JU vision and achievements
Connecting Europe Days	Brussels	2-5 April 2024	European Commission	Exhibition and/or speaking slots to promote the SESAR 3 JU vision and achievements
Transport Research Arena	Dublin	15-18 April 2024	European Commission	Exhibition and/or speaking slots to promote the SESAR 3 JU vision and achievements
Global TBO Symposium	Brussels	4-6 June 2024	SESAR 3 JU, EASA, EUROCONTROL	An event to promote discussion on Trajectory-Based Operations with the global ATM community.
14th SESAR Innovation Days	Rome	12-15 November 2024	SESAR 3 JU	A conference of exhibitions, networking and other activities (e.g. poster pitches and industry site visits)
SESAR 3 JU Annual Conference	Brussels	18 February 2025	SESAR 3 JU	Gathering of SESAR community to discuss aviation challenges

[13] https://www.sesarju.eu/sites/default/files/documents/GB/2022/GB(D)04-2022%20Communication%20Strategy%202022-2027.pdf

Event name	Location	Date	Organiser	Comments
				and showcase latest SESAR research achievements. The event will also promote these the launch of the new European ATM Master Plan adopted by the end of 2024.
Joint event with Joint Undertakings	Brussels (TBC)	TBC Q2 2025	SESAR JU and other Joint Undertakings	Joint event by Joint Undertakings at the European Parliament promoting the JU model as a driver for innovation and competitiveness.
25th ICNS Conference	Brussels	8-10 April 2025	EUROCONTROL, the SESAR Deployment Manager, SESAR JU	A conference addressing technology and policy advances in CNS research, development and implementation programmes as well as policies related to CNS/ATM capabilities and applications.
AERODAYS	Warsaw	7-9 May 2025	European Commission	A 3-day scientific and business conference organised by the European Commission attracting some 1,000 participants from the aviation research community.
Airspace World	Lisbon	13-15 May 2025	CANSO	Exhibitions and/or workshops to promote the SESAR 3 JU vision and achievements
Paris Air Show	Paris	TBC 2025	GIFAS	Exhibitions and/or workshops to promote the SESAR 3 JU vision and achievements
15th SESAR Innovation Days	TBC	TBC – Q4 2025	SESAR 3 JU	A conference of exhibitions, networking and other activities (e.g. poster pitches and industry site visits)

Table 1: Key events and conferences for SESAR 3 JU in 2024 and 2025

Furthermore, the following table presents the publications, digital communications and communications coordination currently planned for 2024-2025.

Activity	Date
Application of the SESAR3 JU visual identity (print material: posters, visual graphics, etc.)	**Q1–Q4 2024–2025**
SESAR innovation pipeline – R&I highlights	**Q1 2024 and Q1 2025**
Consolidated annual activity reports	**Q2 2024 and Q2 2025**
SESAR solutions catalogue – web portal updates and thematic extracts	**Q2 2025**
Various brochures/factsheets on SESAR 3 JU R&I (e.g. performance, environment, solutions, results)	**Q1–Q4 2024–2025**
Digital communications	
Digital assets (e.g. thematic portals, videos, animations, virtual reality, augmented reality and gaming)	**Q1–Q4 2024–2025**
Online communications	
E-news (interviews and project news)	**Q1–Q4 2024–2025**
Contributions to external magazines	**Q1–Q4 2024–2025**
Press relations	**Q1–Q4 2024–2025**
Social media campaigns	**Q1–Q4 2024–2025**
Communications coordination	
Online and face-to-face meetings with the Communications Coordination Group	**Q1–Q4 2024–2025**
Project guidance, communications plan reviews and monitoring progress	**Q1–Q4 2024–2025**

Table 2: Main publications and communication activities in 2024 and 2025

3.2.2 Dissemination and exploitation

The SESAR 3 JU will continue to implement actions aimed at raising awareness among beneficiaries about the importance of dissemination of projects' results. The activities are tailored to the specific situations of the projects, depending on the different projects' implementation stages.

Besides continuous monitoring of the dissemination activities related to the projects performed by the members and the partners, during the implementation of these activities (according to the applicable periodicity and certainly at the final reporting stage), the SESAR 3 JU will ensure that the requirements of the grant agreements in this regard are met.

3.3 Procurement and contracts

For 2024–2025, the SESAR 3 JU will assign the necessary funds for procurement covered by administrative appropriations. Annex II provides indicative information on the planned procurement and contract activities for 2024-2025 for planning and transparency purposes only.

3.4 Other support operations

3.4.1 Legal and procurement support for operations

In the field of legal and procurement support for operations, in 2024 and 2025 the SESAR 3 JU will carry out the following actions.

For legal affairs

- Develop legal analysis on various matters. This analysis aims to:
  - ensure the regularity and legality of all of the SESAR 3 JU's binding agreements, contracts, grants, decisions, processes and measures;
  - monitor the implementation compliance of the agreements concluded with the SESAR 3 JU's founding members (Membership Agreement and Administrative Agreement) as well as with the European Commission (Delegation Agreement(s)) in compliance with the Single Basic Act;
  - appropriate support for the activities aimed at defining the future of the SESAR 3 JU and of the programmes it implements.
- Such analysis could take the form of:
  - legal advice, opinions, legal risk assessments and related mitigation actions;
  - the drafting of agreements and legal documents in strict compliance with the Single Basic Act and applicable regulations;
  - participation in the SESAR 3 JU's technical and administrative projects;
  - drafting, reviewing or updating SESAR 3 JU's internal rules and procedures.
- Coordinate with the European Commission and relevant SESAR 3 JU stakeholders with regard to legal aspects of:
  - Support the internal governance;
  - Participate in interagency legal and procurement networks (the Inter Agencies' Legal Network and the Network of Agencies' Procurement Officers) as well as in Horizon Europe legal networks (the Legal Mechanism Issue Group and the Common Implementation Centre ad hoc meetings).

For procurement

- Provide legal and procedural support and advice for the effective implementation of the procurement plan for 2024 and 2025 (see Annex II): preparation, launch and administration of procurement procedures and contracts.
- Develop legal and procedural analysis on various matters in the field of procurement in view of the rules and regulatory framework applicable to SESAR 3 JU procurement and contract management. Such analysis could take the form of legal advice, legal risk assessments and related mitigation actions, SESAR 3 JU staff training activities, guidelines or other material on procurement matters as well as drafting, review and/or update of the SESAR 3 JU's internal rules and procedures related to procurement activities.
- Promote automation in the management of procurement and contracts (i.e. e-tendering, Public Procurement Management Tool ("PPMT") and new modules made available to SESAR 3 JU by the European Commission).
- Liaise with other JUs and EU agencies in relation to interinstitutional joint procurement and for the creation of synergies and efficiencies between JUs under the Back Office Arrangement for procurement services.

3.4.2 Corporate planning and reporting activities

In the field of corporate planning and reporting activities, and in continuation with activities carried out over the recent years, in 2024 and 2025 the SESAR 3 JU will carry out the following actions.

For corporate planning

- Following consultation with the SRG and the SC as necessary, the SESAR 3 JU will prepare and submit to the GB any necessary amendments of the 2024-2025 BAWP.
- Following consultation with the SRG and the SC as necessary, the SESAR 3 JU will prepare, develop and submit the 2026–2027 BAWP to the GB for adoption in Q4 of 2025.
- Should a readjustment following the regulatory reviews by the European Commission determine this as necessary, the SESAR 3 JU would also carry out the review of the MAWP.
- If necessary, the SESAR 3 JU would amend the BAWP 2024-2025 in response to any readjustment in the priorities following the update of the European ATM Master Plan.

For corporate reporting

The SESAR 3 JU will develop its *Consolidated Annual Activity Report 2023* and its *Consolidated Annual Activity Report 2024* and submit them to the Budgetary Authority respectively by 30 June 2024 and 30 June 2025.

The SESAR 3 JU will also provide inputs to the Biennial Monitoring Reports for the European Partnerships established under Horizon Europe.

Finally, the SESAR 3 JU will continue delivering the work packages as foreseen in the contribution agreement[14] between the European Commission and the SESAR 3 JU.

3.4.3 Data protection

In 2024 and 2025, the SESAR 3 JU will continue ensuring compliance of its processes and tools for processing operational and administrative data with the applicable rules on Data Protection and the European Data Protection Supervisor (EDPS) recommendations by focusing on the following activities:

- Continuing preparing records for new possible processing of personal data and related data protection notices.
- Preparation of written arrangements on joint controllership, when necessary.
- Performing of a Data Protection Impact Assessment in case the processing of personal data, taking into account its nature, scope, context and purposes, is likely to result in a high risk to the rights and freedoms of natural persons.
- Continuing addressing queries from the EDPS & data subjects and providing training on data protection.

In this context, the implementation of all initiatives by SESAR 3 JU will duly incorporate data protection safeguards as prescribed in Article 35 of the Single Basic Act and Regulation (EU) 2018/1725 of the European Parliament and of the Council (EUDPR).

[14] Contribution Agreement MOVE/E3/CA/SESAR3JU/662-2021/SI2.883337 - SESAR 3 Joint Undertaking's technical assistance for the DSDs.

Considering the temporary EDPS authorisation granted to use the SESAR 3 JU – EUROCONTROL Data Protection Administrative Arrangement (DPAA).[15], SESAR 3 JU in close cooperation with EUROCONTROL will seek the renewal of the EDPS authorisation in 2024.

3.4.4 Information and communications technology management

ICT services and infrastructure will continue to be provided to the SESAR 3 JU by EUROCONTROL, delivered by the Network Manager (responsible for contracting and organising ICT services and infrastructure for all EUROCONTROL divisions). The details of the scope of services, assets and management of change are based on the individual service requests, offers and agreements covering the requested scope and within the budget agreed. An architecture model and appropriate security arrangements are maintained to ensure adequate information segregation while ensuring that the SESAR 3 JU benefits from the economy of scale.

In addition to services from EUROCONTROL, the SESAR 3 JU also uses corporate services and common procurement, under an SLA, with the European Commission's Directorate-General for Informatics.

To coordinate and provide a local focal point, the SESAR 3 JU continues to outsource (via a services contract) an independent coordination service (ICT coordination services) that is responsible for planning and coordinating delivery, upgrade and change projects, as well as being the focal point on ICT matters for staff and other suppliers. The ICT coordination services will continue to support the SESAR 3 JU by:

- providing expert advice and input in the fields of ICT, unified communications and business continuity management;
- providing a stable and continuously accessible teleworking infrastructure;
- ensuring minimal interruptions to service and the continuity of support arrangements acting as an interface with ICT suppliers (EUROCONTROL, DIGIT and other third parties).

In addition to the ICT Coordination services, other services, including specialist cyber security and Data Protection expertise will continue to be delivered from contracted services in complement of what is provided from EUROCONTROL and available via DIGIT contracts.

During the years 2024-2025, continuous care will be taken to ensure that the ICT infrastructure and the operating environment are suitable to meet the needs and budget of the SESAR 3 JU. The configuration is managed through internal governance (the Common Services Change Board).

3.4.5 Facility and support services

Facility and support service activities are related to the following administrative tasks and services:

- facilities management, in particular with regard to EUROCONTROL as the owner of the premises, logistics service providers and suppliers;
- mission coordination;
- insurance management, ensuring necessary coverage and the follow-up of any insurance claim.

[15] Data Protection Administrative Arrangement ref. S3JU/LC/006-CTR signed with EUROCONTROL on 15/12/2022, amendment signed on 09/10/2023.

In 2024-2025 the SESAR 3 JU facility services will continue maintaining the interaction and coordination with the corresponding EUROCONTROL services under the SESAR 3 JU-EUROCONTROL agreement. The SESAR 3 JU maintain under its remit some few services, like the Reception.

3.5 Human resources

3.5.1 Human resources management

The SESAR 3 JU foresees stable human resources over the years 2024 – 2025 subject to authorisation by the Budgetary Authority in 2024 and 2025.

3.5.1.1 *Recruitment and management of human resources*

Following the Single Basic Act, the body of staff of the SESAR 3 JU consists of temporary agents (TAs) and contract agents (CAs) who are subject to EU's staff regulations. On 31 December 2023, the SESAR 3 JU has three open positions, one AST4 and one AD5, for which recruitment is ongoing, and one seconded national expert. Once these positions are filled the SESAR 3 JU will operate at full capacity.

3.5.1.1.1 Statutory staff recruitment policy

The SESAR 3 JU launches recruitment procedures aligned with the European Commission processes, for TAs through the announcement of vacant posts on its website and the website of the European Personnel Selection Office. The SESAR 3 JU could also recruit CAs from the European Personnel Selection Office's reserve lists.

The Executive Director is the appointing authority of the SESAR 3 JU, as delegated by the GB.

3.5.1.1.2 Other personnel working at SESAR 3 JU and managed by the SESAR 3 JU

Seconded national experts
The SESAR 3 JU recruits seconded national experts from competent national organisations in the EU Member States, especially where expertise within regulators, public authorities or other public bodies is required. Two seconded national expert positions are authorised in 2023, 2024 and 2025, one of which being occupied end of 2023.

Interim services
The SESAR 3 JU may engage interim staff on and on short-term contracts through temping agencies in either of the following cases:

- the necessary replacement of TAs or CAs in a situation of their long-term absence, and for the duration of such an absence;

  or

- unforeseen additional tasks implying a level of additional workload that cannot be carried out by the existing TAs and CAs.

For these cases, the SESAR 3 JU uses a framework contract (reference HR/R1/PR/2019/023), for the period 1 July 2020 to 30 June 2024, to be renewed. The budget available for this procurement is equivalent to six full-time equivalents (FTEs) per year during a 4-year period.

Blue book trainees

The SESAR 3 JU offer traineeships to blue book trainees through the SLA signed with the European Commission. The maximum capacity of the SESAR 3 JU to host blue book trainees, in accordance with the SLA, is four trainees per traineeship period.

Atypical trainees

The SESAR 3 JU may occasionally accept atypical trainees for short-term traineeships, without a financial impact for the SESAR 3 JU.

3.5.1.2 *Appraisal of performance and reclassification/promotions and mobility policy*

For the reclassification and appraisal of TAs and CAs, the SESAR 3 JU is aligned with the Commission's implementing rules.

For internal and external mobility opportunities for the SESAR 3 JU staff, the SESAR 3 JU makes the vacancy notices accessible internally as well as externally while mobility for SESAR 3 JU staff is possible between the EU agencies.

3.5.1.3 *Gender representation and geographical balance*

The SESAR 3 JU ensures equal opportunities and geographical balance in its selection and recruitment processes. Currently the ratio is 54% female and 46% male staff, covering nationalities from 12 EU countries.

3.5.1.4 *Schooling*

The European Schools in Brussels cover the schooling needs of children of SESAR 3 JU staff, for eligible members of staff.

3.5.2 Staff establishment plan

Function group and grade	2023				2024		2025	
	Authorised budget		Actually filled as of 31 December 2023		Authorised budget		Envisaged budget	
	Permanent posts	Temporary posts	Permanent posts	Temporary posts	Permanent posts	Temporary posts	Permanent posts	Temporary posts
AD16								
AD15								
AD14		1		1		1		1
AD13		2		1		2		2
AD12		3		3		3		3
AD11		5		3		5		5
AD10		2		2		2		2
AD9		8		6		8		8
AD8		7		5		7		7
AD7		3		5		3		3
AD6				3				
AD5				1				
Total AD		**31**		**30**		**31**		**31**
AST11								
AST10								
AST9		1		1		1		1
AST8								
AST7		1				1		1

Function group and grade	2023 Authorised budget		2023 Actually filled as of 31 December 2023		2024 Authorised budget		2025 Envisaged budget	
	Permanent posts	Temporary posts	Permanent posts	Temporary posts	Permanent posts	Temporary posts	Permanent posts	Temporary posts
AST6								
AST5		3		2		3		3
AST4		1		1		1		1
AST3								
AST2				1				
AST1								
Total AST		**6**		**5**		**6**		**6**
AST/SC6								
AST/SC5								
AST/SC4								
AST/SC3								
AST/SC2								
AST/SC1								
Total AST/SC		**6**		**5**		**6**		**6**
Overall total		**37**		**35**		**37**		**37**

Table 3: Staff establishment plan for TAs for years 2023-2025

Function group	2023			2024	2025
	FTE corresponding to authorised budget	Executed FTE as of 31 December 2023	Headcount as of 31 December 2023	FTE corresponding to envisaged budget	FTE corresponding to envisaged budget
IV	1	1	1	1	1
III					
II					
I					
Total	**1**	**1**	**1**	**1**	**1**

Table 4: Staff establishment plan for CAs for years 2023-2025

Seconded national experts	2023			2024	2025
	FTE corresponding to authorised budget	Executed FTE as of 31 December 2023	Headcount as of 31 December 2023	FTE corresponding to envisaged budget	FTE corresponding to envisaged budget
Total	**2**	**1**	**1**	**2**	**2**

Table 5: Staff establishment plan for SNEs for years 2023-2025

3.6 Efficiency gains

The SESAR 3 JU will benefit from the following efficiency measures which will be continued in the period of reference.

- **Collaboration with other JUs.** The SESAR 3 JU will continue close cooperation and ensure coordination with other European partnerships. This includes SESAR 3 JU participation to selection board for the recruitment of technical experts (e.g. project officer, head of unit), when required to strengthen the technical and management relationship between the JUs.
- **Back Office Arrangements.** As per Article 13 of the Single Basic Act, the JUs implement back office arrangements. Although exempted from this provision, as per article 158 of the Single Basic Act, the SESAR 3 JU capitalises on shared back office services[16] and, in particular, is actively involved in the back office arrangements in the field of human resource, accounting and procurement support services. The SESAR 3 JU will continue seeking efficiency gains through initiatives such as sharing services with other JUs, agencies and/or the Commission, including for instance interagency and inter-institutional procurements, common services defined in the back office arrangements with other JUs, EU Agencies Network shared services catalogue.
- **Collaboration with EUROCONTROL.** In application of Articles 157(g) and 158 of the Single Basic Act, the SESAR 3 JU established an agreement with EUROCONTROL in 2022, which governs the provision of infrastructure and logistics support, ICT and other services to the SESAR 3 JU. On this basis, the SESAR 3 JU will seek maximum synergies with EUROCONTROL regarding the services that the latter can make available in this framework.
- **Collaboration with the European Commission.** The SESAR 3 JU will leverage synergies from the use of European Commission's ICT systems and services. The ICT systems supplied by the Commission are in particular related to:
  - financial management and accounting systems (attribute-based access control (ABAC));
  - human resources management (SYSPER job information system modules, DOC Engine);
  - the management of Horizon Europe calls for proposals and grants;
  - procurement (e-procurement);
  - mission management (MIPS);
  - document management, advanced records system (ARES), to be deployed during 2024-2025.
- **Leverage best practices for corporate productivity through the SESAR 3 JU Common Services Change Board (CSCB).** This internal board, dedicated to maintaining the integrity and coherence of SESAR 3 JU common services[17], provides a structured and systematic approach for prioritisation and pre-approval of projects with a corporate impact.

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[16] As per the Administrative Agreement placed between SESAR 3 Joint Undertaking and EUROCONTROL under Art. 157 and 158 of the Single Basic Act (ref. S3JU/LC/005-CTR) as well as the service level agreements for the provision of back office services placed between SESAR 3 JU and the other joint undertakings under Art. 13 of the Single Basic Act.

[17] Quality Management System, ICT scope and services, Business Applications, Business Continuity Management, Information and Document Management; Information Security compliance, Data Protection compliance

4 Governance

4.1 Bodies of the SESAR 3 Joint Undertaking

The governance bodies of the SESAR 3 JU are outlined in section 3.1 of the MAWP. With reference to the Single Basic Act of the SESAR 3 JU, the governance is depicted in Figure 7.

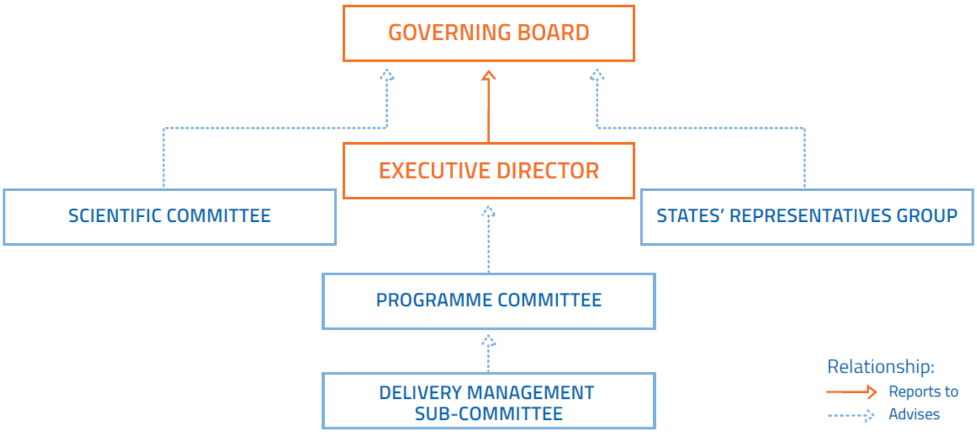

Figure 7: SESAR 3 JU governance

4.1.1 Governing Board

The composition[18], functioning and tasks of the SESAR 3 JU GB are outlined in the Single Basic Act.

The GB will hold at least two ordinary meetings per year as per article 16 of the Single Basic Act. Table 6 provides a provisional timetable for key GB activities and decisions in 2024 and 2025.

Q2 2024	Adopt the Consolidated Annual Activity Report 2023
	Deliver an opinion on the Final Accounts 2023
	Assess, approve or reject the application for associated members
Q4 2024	Adopt the European ATM Master Plan update
	Take note of the strategic development and deployment monitoring reports covering 2023
	Adopt an amendment to the BAWP 2024–2025 with regard to the budget 2025 and the call texts for ER3 and IR2 consistent with the outcome of the new European ATM Master Plan
	Adopt the Internal Audit Capability's work plan for 2025
Q2 2025	Adopt the Consolidated Annual Activity Report 2024
	Deliver an opinion on the Final Accounts 2023
Q4 2025	Adopt the BAWP 2026-2027
	Take note of the strategic development and deployment monitoring reports covering 2024
	Adopt the Internal Audit Capability's work plan for 2026

Table 7: Provisional timetable for key Governing Board activities and decisions in 2024 and 2025

[18] The full list of SESAR 3 JU members and their constituent entities is published on the SESAR 3 JU website.

4.1.2 Executive Director

The functions of the Executive Director (ED) derive from the Single Basic Act.

4.1.3 States' Representatives Group

The role of the States' Representatives Group (SRG) is described in Articles 20 and 153 of the Single Basic Act.

The SRG will hold two meetings per year and will review information and provide opinions notably on the programming documents, on the CAAR, and on the programme progress and achievement of its targets and expected impacts as part of Horizon Europe. On a yearly basis, it will provide to the GB a report on national and regional research and innovation activities related to the deployment and uptake of relevant technologies and innovative solutions. The report will be useful to identify synergies.

4.1.4 Scientific Committee

The role of the Scientific Committee (SC) is described in Articles 21 and 154 of the Single Basic Act.

The SC will hold at least two meetings each year and will advise on the scientific priorities to be addressed in the work programmes and, in this context, will be consulted on the content of all research calls. It will also provide information to the GB on issues and topics of interest determined by the SC or reply to requests from the GB.

4.2 Advisory body to the Executive Director

4.2.1 SESAR 3 Joint Undertaking Programme Committee

The role of the SESAR 3 JU Programme Committee (PC) is described in Section 3.1.2.1 of the MAWP.

A total of four meetings per year will be initially scheduled to support the SESAR 3 JU in the management of the programme. Ad hoc meetings could be scheduled should it be required by the progress of the programme.

In a consultative role to support the SESAR 3 JU ED, the main expected coordination activities of the PC for 2024-2025 will consist in:

- approving the release 14 & 15 plans and close – out reports;
- monitoring both operational and financial progress of the release 14 and 15, as well as issues and risks;
- identifying the impact and proposing means of mitigation for risks and issues whether programmatic, resource related, technical or operational to ensure alignment with the European ATM Master Plan;
- contributing to the consultation phases leading to the definition of the technical specifications for the ER3 and IR2 calls;
- provide strategic input to the update of the European ATM Master Plan and annual strategic development and deployment monitoring reports;
- making recommendations to facilitate an accelerated market uptake of SESAR solutions (demonstrators with early movers, coordination with EASA to help evolve regulatory measures, support standardisation activities).

5 Strategy and plans for the organisational management and internal control systems

5.1 Financial management

The SESAR 3 JU will continue to ensure the transparent and effective management of financial resources and a high level of budget implementation (in terms of both commitments and payments). It will pay particular attention to minimise late payments.

During 2024 and 2025, the SESAR 3 JU will continue to streamline workflows within the SESAR 3 JU's finance-related IT systems and to maintain a high level of accuracy in budgetary forecasting.

The procedures and tools at the SESAR 3 JU related to services contracted to the European Commission's Directorate-General for Budget such as treasury services will continue to be implemented in accordance with the service agreements. Since December 2022, services such as the central budgetary framework, recovery actions, the validation of local systems and financial reporting are offered through the Back Office Arrangement for Accounting services with EU-Rail as lead JU.

5.1.1 Financial monitoring and control

In 2024 and 2025, the SESAR 3 JU will ensure the reliability and completeness of the financial information necessary for the budgetary execution. The SESAR 3 JU's budget implementation financial procedures, circuits and controls will be monitored through diverse axes certifying adequate and efficient documentation with appropriate scrutiny and quality control of the implemented budget.

This will require:

- evaluation of the financial processes and circuits in the finance and budget field, with adaptation to any new financial rules when necessary;
- an analysis of *ex ante* control in terms of risk and efficiency;
- reviews of the accessibility and correctness of reports;
- deployment and documentation through dashboards;
- ensuring the accuracy of ABAC workflow users and access rights.

5.2 Internal control, risk management and audits

As an integral part of its Quality and Internal Control Policies, the SESAR 3 JU deploys a Quality Management System that aims at ensuring that operational activities are effective and efficient, legal and regulatory requirements are met, financial and other management reporting is reliable, assets and information are safeguarded, fraud and irregularities are prevented, detected, corrected and followed-up, risks are adequately managed. As part of its operational objective of transforming the organisation towards a greener and more digital place to work, it is foreseen to update the QMS to reflect the SESAR 3 JU set-up, and to upgrade the Quality and Document management system (with a migration to ARES and to SharePoint online) supported by a service contract[19].

[19] Cf. Table in Annex II, ref. Ad. 33.

Audit functions remain formally separated from quality and internal control to preserve the independent and objective assessment of financial and non-financial controls by external and internal auditors.

5.2.1 SESAR 3 Joint Undertaking's internal control

In 2024 and 2025, the SESAR 3 JU will continue to operate an effective and compliant internal control and its monitoring, including maintaining a risk register and associated treatment actions in accordance with the applicable policy and will follow up on all audit recommendations to ensure proper closure in the appropriate timescale.

The internal control framework is built upon the European Commission 17 principles and best practices shared across the network of agencies and JUs. The measurements and reporting associated with internal control have been assessed by the European Court of Auditors and found to be satisfactory for purpose, it is on this foundation the SESAR 3 JU continues to maintain, and when necessary improve its internal control implementation.

In continuity with the previous years, the SESAR 3 JU will carry out corporate management team annual reviews to assess and monitor the performance of the SESAR 3 JU by assessing each of the relevant indicators for all internal control principles and related characteristics. The consolidated annual activity reports will report on these indicators.

5.2.2 *Ex ante* controls

Ex ante controls will remain important tools to help the SESAR 3 JU to prevent errors and to avoid the need for *ex post* corrective actions. In accordance with Article 74 of the EU financial regulation and Article 21 of the SESAR 3 JU's financial rules, '*each operation shall be subject at least to an ex ante control relating to the operational and financial aspects of the operation, on the basis of a multiannual control strategy which takes risk into account*'. The main objective of *ex ante* controls, therefore, is to ensure that the principle of sound financial management is applied. In 2024 and 2025, the following *ex ante* activities will take place:

- generating and checking grant agreements;
- initiating, checking and verifying invoices for administrative expenditure;
- assessing periodic reports from grants and verifying and paying cost claims.

5.2.3 *Ex post* controls

One of the other major pillars of assurance for the SESAR 3 JU is its *ex post* audit activity. Its main objectives are as follows:

- providing the authorising officer with the necessary elements of assurance on the operational expenditure in a timely manner;
- assessing the regularity and legality of the transactions;
- attaining residual error rates at an acceptable level at the closure of the SESAR 2020 programme, once the financial impact of all audits and correction and recovery measures has been taken into account;
- determining the sound financial management of the transactions, with the support of the internal or external technical experts, with the overall objective being to assess the value for money of the SESAR 3 JU's operations;

- identifying systemic errors through the analysis and synthesis of the results obtained and formulating recommendations to address the issues;
- providing the SESAR 3 JU auditees with recommendations to improve the financial management, processes, procedures and practices applied to the activities related to the SESAR 3 JU's contracts, with the main purpose being to ensure that recurring errors are avoided by the SESAR 3 JU beneficiaries.

For Horizon 2020 projects, in 2024, the audit activity is expected to encompass (according to the Horizon 2020 audit strategy) audits in 13 participations performed by CAS, as well as the follow-up and closure of any pending audits previously launched, regular meetings and the exchange of information.

In 2025, the audit activity will encompass the first Horizon Europe audits to be performed by CAS. For all of these activities, the SESAR 3 JU actively participates in the CAS coordination mechanisms. The SESAR 3 JU will contribute to the implementation strategy for Horizon Europe, in particular by participating in discussions and making proposals for a common audit approach on common financial rules.

5.2.4 Corporate risk management

Table 8 presents a summary of the most significant risks[20] to be noted for the SESAR 3 JU and its activities in 2024 and 2025 as extracted from the risk register. The risks were defined and maintained through the risk assessment exercise performed by the SESAR 3 JU's management[21].

[20] Those with a criticality score higher than 8 (high and moderate level).

[21] The SESAR 3 JU's management conducted a risk assessment exercise on 7 November 2024. Consequently, the risk register has been updated and the changes reflected in Table 8 of the 2nd Amended BAWP 2024-2025.

Risk reference	Description of risk	Affected objective(s) ([22])	Criticality	Summary of risk mitigation
MP 31	Due to limited resources, the SESAR 3 JU may be unable to engage as actively as necessary in international activities, in particular at ICAO level, to ensure the global interoperability that would support the acceptability of SESAR solutions.	Ensure global interoperability through active engagement with international partners in particular towards the 42nd ICAO Assembly in 2025	Medium	• Monitor closely developments at ICAO level in close coordination with the European Commission, EASA and EUROCONTROL benefitting from existing synergies and exchanges at technical level. Alignment between the Global Air Navigation Plan (GANP) and the updated European ATM Master Plan

Table 8: SESAR 3 JU critical risks and related mitigation actions

5.2.5 Strategic risk assessment

In June 2022, the Internal Audit Service (IAS) conducted a strategic risk assessment of the SESAR 3 JU. This entailed the IAS assessed risks related to operational, administrative, financial and IT processes of the SESAR 3 JU, with the aim of identifying areas of risk and future audit topics. This strategic risk assessment was performed in coordination with the SESAR 3 JU Internal Audit Capability, and led to the 2023–2025 strategic internal audit plan[23], which was published in September 2022.

The next in-depth risk assessment by the IAS is planned for 2026.

5.2.6 Anti-fraud strategy

The SESAR JU Administrative Board adopted the third SESAR 3 JU anti-fraud policy (2023-2025)[24], which builds on the previous versions while including a strong focus on the DES programme.

5.2.7 Audits

5.2.7.1 *Internal Audit Capability*

The SESAR 3 JU's Internal Audit Capability will perform audits and consulting engagements based on risks identified in 2024 and 2025. It will also coordinate activities with the Internal Audit Service (IAS) and the European Court of Auditors. The 2024 annual audit plan of the Internal Audit Capability was presented to the GB in Q4 2023. The 2025 annual audit plan of the Internal Audit Capability will be presented to the GB in Q4 2024.

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[22] This column identifies which operational objective (as identified in section 2.2) may be affected by the risk, should it occur.

[23] Internal Audit Service, strategic internal audit plan for the SESAR 3 JU for the period 2023 – 2025, Ref Ares(2022)6677146-28/09/2022.

[24] SESAR 3 JU Governing Board Decision GB(D)09-2023 on the SESAR 3 JU anti-fraud strategy 2023-2026 of 26 June 2023.

5.2.7.2 *Internal Audit Service*

Internal audits are carried out by IAS in liaison with the Internal Audit Capability. The IAS has listed the prospective audit topics for the years 2023, 2024 and 2025 in the strategic internal audit plan 2023–2025[25].

In 2024, the IAS plans to audit the SESAR 3 JU in-kind contributions validation process.

In 2025, the IAS could audit the SESAR 3 JU Back Office Arrangements, which is identified as a reserve topic.

5.2.7.3 *European Court of Auditors*

Every year, the ECA provides the EP and the Council with a statement of assurance of the reliability of the annual accounts of the JU and the legality and regularity of the underlying transactions, based on an audit of the SESAR 3 JU accounts. The fieldwork related to the audit of the accounts 2023 is expected to start in January 2024 (final report publication in November 2024), the fieldwork related to the audit of the accounts 2024 is expected to start in January 2025 (final report publication in November 2025) and the fieldwork related to the audit of the accounts 2025 is expected to start in January 2026 (final report publication in November 2026).

5.3 Business continuity management

In 2023, the SESAR 3 JU initiated the process to update its Business Continuity Management Plan, and during 2024 and 2025 this process will be finalised and tested, in particular from the perspective of a major ICT failure or a Cyber Security breach.

[25] Internal Audit Service, strategic internal audit plan for the SESAR 3 JU for the period 2023 – 2025, Ref Ares(2022)6677146-28/09/2022.

Chapter III – Budget

The SESAR 3 JU budget has to be adopted by the GB on basis of the EU contribution as foreseen in the adopted EU General Budget. The Draft Budget prepared a year before by the SESAR 3 JU in close collaboration with the European Commission services is meant to participate in the preparation of the EU General Budget as far as the EU contribution to the SESAR 3 JU is concerned.

As per Article 110 of the EU financial regulation ([26]), *'a budgetary commitment shall be preceded by a financing decision adopted by the Union institution or by the authority to which powers have been delegated by the Union institution*'. This financing decision must set out certain essential elements for actions involving expenditure from the budget for grants, procurements and prizes. The BAWP for 2024-2025 constitutes the financing decision for 2024 as well as for 2025, following the adoption of its second amended version by the GB on 12 December 2024. The global budgetary envelops reserved for the grants in 2025 is EUR 254 million, and EUR 8 463 088 for the procurements.

It should be noted that, in accordance with Article 110(5) of the EU financial regulation and the principle of sound financial management, the SESAR 3 JU authorising officer may decide to make non-substantial changes and amend the indicative budget or timing for a given procurement procedure if this allows for improved adherence to the SESAR 3 JU's objectives. A change of more than 20% in the volume of appropriations, the introduction of a new action or other changes affecting the strategic choices in the work programme are to be considered substantial.

1 Budget 2025[27]

1.1 Revenue

Statement of revenue					
Title/chapter	**Heading**	**Financial year 2024**		**Financial year 2025**	
		commitment appropriations	payment appropriations	commitment appropriations	payment appropriations
EU contribution (excluding European Free Trade Association (EFTA) and third countries' contribution) ([28])	**1**	**91 088 542**	**83 372 452**	**87 689 782**	**90 587 212**
of which (fresh C1) administrative (Titles 1 and 2)		2 628 062	2 628 062	3 172 824	3 172 824

[26]Regulation (EU, Euratom) 2024/2509 of the European Parliament and of the Council of 23 September 2024 on the financial rules applicable to the general budget of the Union (recast), OJ L, 2024/2509, 26.9.2024.

[27] Commitment and Payment appropriations are subject to the adoption of the EU General Budget for 2025. All figures may be updated after the adoption procedure

of which frontloaded commitments (Titles 1 and 2)	**1.1**		2 991 969		
of which operational (Title 3 & 4)	**1.1**	88 460 480	77 752 940	84 516 958	87 414 388
Of which C2 Operational (Title 4)					
of which related to additional entrusted tasks					
EFTA and non-EU countries' contribution	**1.1**	**3 224 534**	**2 935 742**	**12 078 135**	**12 157 814**[29]
of which administrative EFTA (Titles 1 and 2)	**1.1**	93 033	183 288[30]	87 253	87 253
of which administrative third countries excluding EFTA (Titles 1 and 2)	**1.1**				
of which operational EFTA (Title 4)	**1.1**	3 131 501	2 752 454[31]	2 324 216	2 403 896
of which operational third countries excluding EFTA (Title 4)	**1.1**			9 666 666[32]	9 666 666
Financial members other than the EU contribution	**2.1; 3.1**	**8 270 374**	**8 270 374**	**7 142 857**	**7 142 857**
of which administrative (Titles 1 and 2)		8 270 374	8 270 374	7 142 857	7 142 857
of which operational (Title 3)					
Financial contributing					

[29] € 1 difference due to rounding.

[30] The amount is composed of € 90 255 (EFTA H2020 rate 3%) and € 93 033 (EFTA HE rate 3.54%).

[31] EFTA Horizon Europe rate 3.54% applied.

[32] UK additional revenue

partners' contribution					
Interest generated					
Unused appropriations from previous years	**5.1**	**5 610 782**	**11 469 309**[33]	**57 929 237**	**261 524**
of which administrative		5 097 714	7 852 579	458 274	261 524
of which operational		513 068	3 616 731	57 470 963	0
Total revenue		**108 194 232**	**106 048 396**	**164 840 012**[34]	**110 149 408**

Table 9: SESAR 3 JU revenues in 2024 and 2025 – commitment & payment appropriations

1.2 Expenditure

STATEMENT OF EXPENDITURE					
Title Chapter	**Heading**	**Financial YEAR 2024**		**Financial YEAR 2025**	
		commitment appropriations	payment appropriations	commitment appropriations	payment appropriations
1. Staff					
Salaries and allowances	**11**	**6 175 801**	**6 230 177**	**6 576 710**	**6 576 710**
of which establishment plan posts		5 604 982	5 604 982	5 974 900	5 974 900
of which external personnel		570 819	625 195	601 810	601 810
Expenditure relating to staff recruitment	**12**	**5 000**	**5 000**	**10 000**	**10 000**
Mission expenses	**13**	**250 000**	**268 652**	**275 000**	**275 000**
Socio-medical infrastructure	**14**				
Training	**15**	**60 000**	**60 000**	**60 000**	**60 000**

[33] € 1 difference due to rounding.

[34] € 1 difference due to rounding.

STATEMENT OF EXPENDITURE					
Title Chapter	**Heading**	**Financial YEAR 2024**		**Financial YEAR 2025**	
		commitment appropriations	payment appropriations	commitment appropriations	payment appropriations
External services	**16**	**122 953**	**122 953**	**146 847**	**146 847**
Receptions, events and representation	**17**				
Social welfare	**18**				
Other staff-related expenditure	**19**	**20 000**	**20 000**	**50 000**	**50 000**
2. Infrastructure and operating					
Rental of buildings and associated costs	**20**	**258 181**	**465 780**	**203 000**	**196 250**
ICT and data processing	**21**	**2 075 620**	**3 822 790**	**2 121 359**	**2 121 359**
Movable property and associated costs	**22**	**10 000**	**15 000**	**5 000**	**5 000**
Current administrative expenditure	**23**	**494 247**	**529 281**	**793 293**	**793 293**
Postage/telecommunications	**24**				
Meeting expenses	**25**	**30 000**	**50 558**	**25 000**	**25 000**
Running costs in connection with operational activities	**26**				
Information and publishing	**27**	**524 014**	**793 665**	**595 000**	**405 000**
Studies	**28**				
Other infrastructure and operating expenditure					
Total administrative (1 + 2)		**10 025 816**	**12 383 855**[35]	**10 861 208**[36]	**10 664 458**[37]
3. Operational					

[35] € 1 difference due to rounding.

[36] € 1 difference due to rounding.

[37] € 1 difference due to rounding.

STATEMENT OF EXPENDITURE						
Title Chapter	Heading	Financial YEAR 2024		Financial YEAR 2025		
		commitment appropriations	payment appropriations	commitment appropriations	payment appropriations
SESAR 2020 programme[38]	**3**		1 939 788		
Digital European sky programme	**4**	**92 105 049**	**31 745 321**	**153 978 803**	**33 797 786**
Total operational (3 + 4)		**92 105 049**	**33 685 108**	**153 978 803**	**33 797 786**
Title 5 - Unused Appropriations not required in current Year	5	**6 063 366**	**59 979 433**	**0**	**65 687 163**
Total expenditure		**108 194 232**[39]	**106 048 396**	**164 840 012**	**110 149 408**

Table 10: Detailed SESAR 3 JU expenditure budget 2024 and 2025 – commitment & payment appropriations

1.3 Details of the budgetary statements

1.3.1 Revenue

The operational expenditure is exclusively covered with an EU contribution, including the EFTA contribution. From 2025 on and for the next three years, a significant support package for Ukraine has been approved by the EU budget authority. Therefore, existing programmes (including Horizon Europe) need to contribute. This represents a reduction of the budget attributed to the SESAR 3 JU of EUR 14 million over the next three years, with a cut by EUR 3 million in 2025 in commitment appropriations only. On the contrary, additional revenue coming from the UK for their participation in the HE programme should come soon, amounting to EUR 9 666 666 in 2025.

The administrative expenditure is covered with financial contribution paid by the EU as described in the Legislative Financial Statement (LFS) on the one hand, and by EUROCONTROL and for the first year by the other Members by application of the Membership Agreement.

1.3.2 Expenditure

The 2025 budget has been prepared based on actual expenditure of 2024. A 7% increase was applied on salaries based on 2023 and 2024 actuals. All the positions foreseen in the Staff Establishment Plan (see section 3.5.2) are expected to be covered during the whole year. Most of other budget lines have been increased by 3%.

The operational budget is now only made of Digital European Sky (DES, Title IV), as SESAR2020 programme (Title III) is over, and amounts to EUR 153 978 803 in commitment appropriation. Two

[38] Title 3 SESAR 2020 programme: following closure of the programme, the ongoing evaluation of the unused appropriations should be completed by the first quarter 2025. These appropriations are expected to be inscribed with the Budget 2025 Amendment 1.

[39] € 1 difference due to rounding.

calls ER3 and IR2, with a budget respectively of EUR 24 million and EUR 230 million, are in preparation. The ER3 call will be fully committed towards the end of the year 2025, while IR2 will partly be committed by the end of 2025, with accumulated commitment appropriation. Out of the commitment appropriation, EUR 6 871 942 are for other operational activities (Stellar, Airspace users' support, experts for calls evaluations and deliverables etc.).

The Digital European Sky (DES, Title IV) payment appropriation amounts EUR 33 797 786 for 2025, mainly for the interim payments of the ER1, ER2 and IR1 projects.

2 Second amending Budget 2024[40]

2.1 Revenue

The main purpose of the second amendment to the budget 2024 is to reflect Horizon Europe EUROCONTROL cash Contribution 2024 to the Joint Undertaking's running costs for an amount of EUR 3 571 428.57 as well as its voluntary additional cash contribution amounting to EUR 1 500 000.00. As a result, EUROCONTROL total contribution amounts to EUR 5 071 429 for the year 2024.

2.2 Expenditure

Administrative Budget:

Title 5: Unused appropriations:

EUROCONTROL total contribution EUR 5 071 429, i.e. Contribution 2024 EUR 3 571 428.57 and additional contribution EUR 1 500 000, will remain unused this year. This results in an increase of the administrative unused appropriations to EUR 6 063 366 in commitment appropriations and to EUR 9 542 417 in payment appropriations.

Operational Budget:

Title 4: Digital European Sky

Following the award of the project Travel Wise as part of the Synergy Topic Call agreement "Integrated Air and Rail Network Backbone for a Sustainable and Energy-efficient Multimodal Transport System" between Europe's Rail JU and the SESAR 3 JU; an additional amount of EUR 500 000.00 was reallocated in commitment appropriations. The share of the Grant Agreement supported by SESAR 3 JU now amounts to a maximum of EUR 3 000 000.00.

[40] Cf: Budget tables 9 and 10 for the 2nd Amending Budget 2024

List of abbreviations

Abbreviation	Definition
4D	four-dimensional
4DT	four-dimensional trajectory
A/A	air-to-air
A/G	air-to-ground
ABAC	attribute-based access control
ABAS	aircraft based augmentation system
ACARE	Advisory Council for Aviation Research and Innovation in Europe
ACARS	aircraft communications addressing and reporting system
ACC	area control centre
A-CDM	airport collaborative decision making
ACI	Airports Council International
ADS-B	automatic dependent surveillance broadcast
ADS-C	automatic dependent surveillance contract
ADS-L	automatic dependent surveillance – light
ADSP	ATM data service provider
AF	ATM functionality (CP1)
AFUA	advanced flexible use of airspace
AGL	above ground level
AI	artificial intelligence
AIM	aeronautical information management
AIS	aeronautical information services
AISD	airline information services domain
AMAN	arrival manager
AMC	acceptable means of compliance
AMDAR	aircraft meteorological data relay
ANCEN	Aviation Non-CO_2 Expert Network
ANS	air navigation service
ANSP	air navigation service provider
AOC	airline operational communications
AOP	airport operations plan
AoR	area of responsibility
API	application programming interface
A-PNT	alternative position, navigation and timing
APOC	airport operations centre
AR	applied research
AR	augmented reality
ARA	airspace risk assessment
ARES	European Commission's advanced records system
ASDA	Association of Scientific Development of ATM in Europe
ASM	airspace management
ASMA	arrival sequencing and metering
A-SMGCS	advanced surface movement guidance and control system
ASP	ATM service provider
ASTM	American Society for Testing and Materials
ATC	air traffic control
ATCO	air traffic controller
ATFCM	air traffic flow and capacity management

ATFM	air traffic flow management
ATM	air traffic management
ATMOPS	ICAO ATM operational panel
ATMRPP	ICAO ATM requirements and performance panel
ATN	aeronautical telecommunications network
ATR	average temperature response
ATS	air traffic service
ATSA-SURF	airborne traffic situational awareness on the airport surface
ATSEP	air traffic safety electronics personnel
ATSP	air traffic service provider
ATSU	air traffic service unit
AU	airspace user
AUSA	ATM–U-space shared airspace
AZEA	European Alliance Zero Emission Aviation
B2B	business-to-business
BA	business aviation
BADA	base of aircraft data
BAWP	biannual work programme
BVLOS	beyond visual line of sight
C2	command and control
CA	contract agent
CACD	CFMU airspace and capacity database
CAEP	Committee on Aviation Environmental Protection
CANSO	Civil Air Navigation Services Organisation
CAR	common altitude reference
CAS	Common Audit Service of the Directorate-General for Research and Innovation
CAT	category
CBA	cost–benefit analysis
CCO	continuous climb operations
CCS	capacity constrained situation
CDM	collaborative decision-making
CDO	continuous descent operations
CDTI	cockpit display of traffic information
CEF	Connecting Europe Facility
CFP	critical failure for performance
CFSP	computerised flight plan service provider
CINEA	European Climate, Infrastructure and Environment Executive Agency
CIS	common information service
CISP	common information service provider
CMCoord	civil-military coordination
CNS	communications, navigation and surveillance
CNSaaS	CNS as a service
CO	carbon monoxide
CO_2	carbon dioxide
CONOPS	concept of operations
COT	cloud optical thickness
COTS	Commercial off-the-shelf
CP	common project
CPDLC	Controller/pilot datalink communication
C-PNT	complementary position, navigation, and timing
CSCB	Common Services Change Board

CTR	control zone
C-UAS	counter unmanned aerial system
D&E	dissemination and exploitation
D4S	Data for safety
DA	development action
DAA	detect and avoid
DAC	dynamic airspace configurations
DAR	dynamic airspace reconfigurations
DCB	demand–capacity balancing
DCT	direct route
DER	departure runway end
DES	Digital European Sky programme
DFMC	dual-frequency multi-constellation
DFR	Digital flight rules
DIGIT	Directorate General Informatics of the European Commission
DIMC	drone incident management cell
DMA	dynamic mobile area
DMAN	departure manager
DME	distance-measuring equipment
DMP	data management plan
DMSC	Delivery Management Subcommittee
DP	Development priority
DSD	Digital Sky Demonstrator
DSM	digital surface model
DTG	distance to go
DTM	digital terrain model
EAD	European AIS database
EAP	extended ATC planner
EASA	European Union Aviation Safety Agency
EASCG	European ATM standards coordination group
EASN	European Aeronautics Science Network
ECAC	European Civil Aviation Conference
ECR	European Central Repository
EDA	European Defence Agency
EDAS	EGNOS data access service
eDME	enhanced distance-measuring equipment
EDPS	European Data Protection Supervisor
EEG	electrode electroencephalogram
EFB	electronic flight bag
EFEDA	European Defence Agency
EFTA	European Free Trade Association
EFVS	enhanced flight vision systems
EGNOS	European Geostationary Navigation Overlay Service
EHS	enhanced surveillance
EIS	entry into service
EO	electro-optical
EPAS	European Plan for Aviation Safety
EPC	estimated performance contributions
EPP	extended projected profile
ER	exploratory research
ESA	European Space Agency

ETFMS	enhanced tactical flow management system
ETOT	estimated take-off time
EU	European Union
EUROCAE	European Organisation for Civil Aviation Equipment
EUROCONTROL	European Organisation for the Safety of Air Navigation
EUROSTAT	Statistical office of the European Union
EUSCG	European UAS standards coordination group
EUSPA	European Union Agency for the Space Programme
FAA	US Federal Aviation Administration
FATO	final approach and take-off areas
FCI	future communication infrastructure
FCPC	flexible capacity provision contracts
FCU	flight control unit
FDPS	flight data processing system
FF-ICE	flight and flow information for a collaborative environment
FIFO	first-in-first-out
FIS	flight information service
FMP	flow management position
FMS	flight management system
FOC	flight operations centre
FPL	flight plan
FR	fundamental research
FRA	free route airspace
FSA	first system activation message
FSL	few-shot learning
ft.	feet
FTE	full-time equivalent (staff)
FUA	flexible use of airspace
FUM	flight update message
G/G	ground-to-ground
GA	general aviation
GANP	global air navigation plan (from the International Civil Aviation Organization)
GAST	GBAS approach service type
GATMOC	Global Air Traffic Management (ATM) Operational Concept
GB	SESAR 3 JU Governing Board
GBAS	ground-based augmentation system
GDPR	General Data Protection Regulation
GLS	GBAS landing system
GM	guidance material
GNSS	global navigation satellite system
GPS	global positioning system
GWP	global warming potentials
H_2O	dihydrogen monoxide (water)
HAO	high-altitude operation
HAPS	high-altitude pseudo-satellites
HAWL	hardware assurance level
HC	unburnt hydrocarbons
HLO	high-level operations
HMI	human–machine interface
IAM	Innovative Air Mobility
IAS	Internal Audit Service

IATA	International Air Transport Association
IATF	International Aviation Trust Framework
ICAO	International Civil Aviation Organization
ICAO GANP	global air navigation plan (from the International Civil Aviation Organization)
ICT	information and communications technology
IDMS	information and document management system
IFAV	Increased flexibility of ATCO validations
IFPS	integrated initial flight plan processing system
IFPZ	integrated initial flight plan processing system zone
IFR	instrument flight rules
IKOP	in-kind contributions to operational activities
ILS	instrument landing system
IMC	instrument meteorological conditions
IMU	inertial measurement unit
INAP	Integrated Network Management and extended ATC Planning Function
INS	inertial navigation system
iOAT	improved operational air traffic
IoT	internet of things
IP	Internet Protocol
IPS	Internet Protocol suite
IR	industrial research and validation
ISMS	information security management system
ISO	international organisation for standardisation
IT	information technology
ITU	International Telecommunications Union
JTIDS	Joint Tactical Information Distribution System
JU	joint undertaking
KEA	key performance environment indicator based on actual trajectory
KPA	key performance area
KPI	key performance indicator
LAQ	local air quality
L-DACS	L-band Digital Aeronautical Communications System
LEO	low earth orbit
LIDAR	light detection and ranging
LoA	letter of agreement
LR	long-range aircraft
LRO	launch and re-entry operators
LRSO	launch and re-entry site operators
LTE	long-term evolution
LVC	low visibility conditions
MAWP	multiannual work programme
MCP	mode control panel
MET	meteorological
MIDS	multifunctional information distribution system
ML	machine learning
MLEAP	machine learning application approval
MoC	Memorandum of Cooperation
MoU	Memorandum of Understanding
MP	Master Plan
MRS	minimum radar separation
MSL	mean sea level

MT	mission trajectory
MTM	mission trajectory management
MWS	minimum wake separation
NADP	noise abatement departure procedures
NAV	navigation
NDB	non-directional beacon
NextGen	next generation air transportation system
NGO	Non-governmental organisation
NIA	network impact assessment
NM	Network Manager
NN	neural networks
NOP	network operations plan
NO_X	nitrogen oxides
NP	non-deterministic polynomial time
NR	new radio
NWP	numerical weather prediction
OBACS	on-board braking action computation system
OCO	optimised climb operations
ODO	optimised descent operations
OEM	original equipment manufacturer
OLDI	on-line data interchange
ORP	oceanic, Remote and Polar
OSED	operational services and environment description
OSI	open systems interconnection
PANS-ATM	Procedures for Air Navigation Services – Air Traffic Management
PANS-OPS	Procedures for Air Navigation Services – Aircraft Operations
PBCS	performance-based communication and surveillance
PBN	performance-based navigation
PM	particulate matter
PNT	position, navigation, and timing
PPS	pulse per second
PQC	post-quantum cryptography
PR	public relations
PRB	Performance Review Body
PRS	public regulated service
PRT	permanent resume trajectory
PSR	primary surveillance radar
PUE	power usage effectiveness
PVT	position velocity and time
QC	Quantum computing
QFE	altimeter pressure setting field elevation
QKD	Quantum Key Distribution
QMS	quality management system
QNE	altitude displayed on an aircraft's altimeter when it is set to the standard atmospheric pressure at sea level
QNH	altimeter pressure setting nautical height
QoS	quality of service
R&D	research and development
R&I	research and innovation
R/T	radio telephony
RAD	route availability document

RAM	regional air mobility
RBT	reference business trajectory
RCP	required communication performance
RCS	radar cross section
RECAT	wake turbulence re-categorisation
RF	radio frequency
RFI	radio frequency interference
RIA	research and innovation action
RL	reinforcement learning
RMT	rulemaking task
RNP	required navigation performance
RNP APCH	required navigation performance approach
RP	reference period
RPAS	remotely piloted aircraft system
RRP	re-routing proposal message
RSP	required surveillance performance
RTCA	Radio Technical Commission for Aeronautics
RTK	real time kinematic
RTSP	required total system performance
RVSM	reduced vertical separation minimum
RWC	remain well clear
RWY	runway
RWYCC	runway condition code
SA	situational awareness
SaaS	simulation as a service
SAF	sustainable aviation fuel
SAO	Strategic Area of Operations
SARPs	standards and recommended practices
SatCom	satellite communications
SB	satellite-based
SBAS	satellite-based augmentation system
SC	Scientific Committee, established in accordance with Council Regulation (EU) 2021/2085 Article 154
SDM	SESAR deployment manager
SDO	strategic deployment objective
SecRA	security risk assessment
SecRAM	security risk assessment methodology
SERA	standardised European rules of the air
SES	Single European Sky
SESAR	Single European Sky ATM Research
SESAR 2020	SESAR 2020 innovation R & I programme, also referred to as the 'SESAR 2020 Programme' or 'SESAR 2020 R & I Programme'. It is the coordinated set of activities described in this document, being undertaken by the SESAR JU Members and managed by the SESAR JU
SESAR JU	Single European Sky ATM Research Joint Undertaking, established as a joint undertaking within the meaning of Article 187 of the Treaty on the Functioning of the European Union, established under the SESAR JU basic act
SESAR JU basic act	Council Regulation (EC) No 219/2007 of 27 February 2007 (OJ L 64, 2.3.2007, p. 1) on the establishment of a joint undertaking to develop the new generation European air traffic management system (SESAR), as amended by Council Regulation (EC)

	No 1361/2008 of 16 December 2008 (OJ L 352, 31.12.2008, p. 12) and by Council Regulation (EU) No 721/2014 of 16 June 2014 (OJ L 192, 1.7.2014, p. 1)
SESAR 3 JU	Single European Sky ATM Research 3 Joint Undertaking
SID	standard instrument departure
Single Basic Act	Council Regulation (EU) 2021/2085 of 19 November 2021 establishing the Joint Undertakings under Horizon Europe and repealing Regulations (EC) No 219/2007, (EU) No 557/2014, (EU) No 558/2014, (EU) No 559/2014, (EU) No 560/2014, (EU) No 561/2014 and (EU) No 642/2014, OJ L 427, 30.11.2021, p. 17–119; as amended by Council Regulation (EU) 2023/1782 of 25 July 2023 amending Regulation (EU) 2021/2085 establishing the Joint Undertakings under Horizon Europe, as regards the Chips Joint Undertaking, OJ L 229, 18.9.2023, p. 55–62.
SiPO	Single pilot operations
SLA	service-level agreement
SMEs	small and medium-sized enterprises
SMR	short medium range aircraft
SO_2	sulphur dioxide
SORA	specific operations risk assessment
SO_x	sulphur oxides
SPS	standard positioning service
SRAD	short-range air-data
SRG	States' Representatives Group
SRIA	strategic research and innovation agenda
SRP	short-range particulates
SSA	space situational awareness
SSR	secondary surveillance radar
SST	space surveillance and tracking
STAM	short-term ATFCM measures
STAR	standard terminal arrival route
STCA	Short-term conflict alert
STM	space traffic management
SUR	surveillance
SW	software
SWAL	software assurance level
SWaP	size weight and power
SWIM	system-wide information management
TA	temporary agent
TACAN	tactical air navigation system
TBO	trajectory-based operation
TBS	time-based separation
TCAS	traffic collision avoidance system
TE	technical error value
TIS	traffic information service
TLOF	touchdown and lift-off area
TLS	target level of safety
TMA	terminal manoeuvring area
TOD	top of descent
TOL	take-off and landing
TRL	technology readiness level
TTOT	target take-off time
UAM	urban air mobility
UAS	unmanned aerial system

UAV	uncrewed aerial vehicle
UDPP	user-driven prioritisation process
UDT	unconstrained desired trajectory
U-space	A set of new services relying on a high level of digitalisation and automation of functions, and specific procedures designed to support safe, efficient and secure access to airspace for a large numbers of drones, with an initial look at very low-level operations
USSP	U-space service provider
UTM	uncrewed traffic management
VCA	vertical take-off and landing (VTOL) capable aircraft
VDLM2	VHF digital link mode 2
VEM	VTOL aircraft (conducting flights for medical missions in urban areas)
VFR	visual flight rules
VHF	very high frequency
VLL	very low level
VOC	volatile organic compounds
VOR	VHF omnidirectional range
VR	virtual reality
VTOL	vertical take-off and landing
WA	work area
WER	Wake retrieval energy
WOC	wing operations centre
WOC	wing operations centre (term to be confirmed with military experts)
WS	web service
XAI	explainable artificial intelligence
XR	extended reality

Annexes

Annex I: Annual additional activities plan

Annual additional activities plan 2024 and 2025

Additional Activities type	Estimated annual value in 2024	Estimated annual value in 2025
OVERVIEW ESTIMATED AMOUNT OF IKAA for EUROCONTROL		
1. Support to additional R&I	6.692.000	6.212.000
2. Scale up of technologies	561.000	800.000
3. Demonstrators	3.776.000	4.883.000
4. Creating new business opportunities	100.000	100.000
5. Training & skills development	0	0
6. Contribution to the development of new standards, regulations and policies	4.357.000	6.036.000
7. Supporting ecosystem development	2.701.000	2.807.000
8. Communication, dissemination, awareness raising, citizen engagement	53.000	220.000
Total for EUROCONTROL	**18.240.000**	**21.058.000**
OVERVIEW ESTIMATED AMOUNT OF IKAA for Other Members		
1. Support to additional R&I	15.865.457	26.209.638
2. Scale up of technologies	12.401.086	8.468.805
3. Demonstrators	16.532.072	19.954.439
4. Creating new business opportunities	949.000	0
5. Training & skills development	0	0
6. Contribution to the development of new standards, regulations and policies	6.127.062	904.806
7. Supporting ecosystem development	25.868.224	20.550.243
8. Communication, dissemination, awareness raising, citizen engagement	643.860	572.700
9. Other	23.769.787	53.773.229
Total for other members	**102.156.548**	**130.433.860**
TOTAL ALL PLANNED IKAA	**120.396.548**	**151.491.860**

Annex II: Call for tenders and other actions

The table below present the main procurement activities to be conducted in 2024-2025 covered by operational and administrative appropriations.

Ref.	Budget line(s)	Procurement area	Procurement description	Target signature date	Budget year	Total estimated budget (EUR)	Type of contract/ procedure	Comments
Under operational appropriations								
Op.01	4000	Experts for deliverables and project reviews	Provision of technical expertise for assessing the deliverables and contributing to Horizon Europe projects' review	Ad hoc	2024	10 000	Expert contracts	
Op.02	4000	Experts for deliverables and project reviews	Provision of technical expertise for assessing the deliverables and contributing to Horizon Europe projects' review	Ad hoc	2025	50 000	Expert contracts	
Op.03	4000	Expert call evaluations	Provision of technical expertise for the evaluation of calls for proposals (ER2)	Ad hoc	2024	300 000	Expert contracts	
Op.04	4000	Expert call evaluations	Provision of technical expertise for the evaluation of young scientific award applications	Ad hoc	2024	10 000	Expert contracts	
Op.05	4000	Expert call evaluations	Provision of technical expertise for the evaluation of calls for proposals (IR2 and ER3 calls)	Ad hoc	2025	900 000	Expert contracts	
Op.06	4000	Consultancy and Support to SESAR 3 JU related to Strategic Management and Facilitation of Market Uptake	Provision of independent consultancy for the execution of the SESAR 3 JU programme	Q2	2024	50 000	Specific contract under framework contract ref. S3JU/LC/014-CTR	Complementary activities for the European ATM Master Plan campaign

Ref.	Budget line(s)	Procurement area	Procurement description	Target signature date	Budget year	Total estimated budget (EUR)	Type of contract/ procedure	Comments
Op.07	4000	Consultancy and Support to SESAR 3 JU related to Strategic Management and Facilitation of Market Uptake	Provision of independent consultancy for the execution of the SESAR 3 JU programme	Q2	2024	100 000	Specific contract under framework contract ref. S3JU/LC/014-CTR	New/different set of activities related to the European ATM Master Plan campaign
Op.08	4000	Consultancy and Support to SESAR 3 JU related to Strategic Management and Facilitation of Market Uptake	Provision of independent consultancy for the execution of the SESAR 3 JU programme	Q1	2025	500 000	Specific contract under framework contract ref. S3JU/LC/014-CTR	SC for the preparation of CP2, which includes an activity initially planned for an amount of 50 000€ for Q2 2024
Op.09	4000	Consultancy and Support to SESAR 3 JU Related to Strategic Management and Facilitation of Market Uptake	Provision of independent consultancy for the execution of the SESAR 3 JU programme	Q1	2025	347 260	Specific contract under framework contract ref. S3JU/LC/014-CTR	Specific Contract for MP follow up activities and strategic advice to the SJU
Op.10	4000	Airspace users' expertise	Provision of airspace users' expertise for the execution of the SESAR 3 JU programme	Q4	2024	200 000	Specific contract under the framework contract ref. S3JU/LC/009-CTR – LOT 1	-
Op.11	4000	Airspace users' expertise	Provision of airspace users' expertise for the execution of the SESAR 3 JU programme	Q4	2024	100 000	Specific contract under the framework contract ref. S3JU/LC/010-CTR – LOT 3	-
Op.12	4000	Airspace users' expertise	Provision of airspace users' expertise for the execution of the SESAR 3 JU programme	Q4	2024	100 000	Specific contract under the framework contract ref.	-

Ref.	Budget line(s)	Procurement area	Procurement description	Target signature date	Budget year	Total estimated budget (EUR)	Type of contract/ procedure	Comments
							S3JU/LC/017-CTR – LOT 2	
Op.13	4000	Airspace users' expertise	Provision of airspace users' expertise for the execution of the SESAR 3 JU programme	Q4	2025	100 000	Specific contract under the framework contract ref. S3JU/LC/009-CTR – LOT 1	-
Op.14	4000	Airspace users' expertise	Provision of airspace users' expertise for the execution of the SESAR 3 JU programme	Q4	2025	100 000	Specific contract under the framework contract ref. S3JU/LC/010-CTR – LOT 3	-
Op.15	4000	Airspace users' expertise	Provision of airspace users' expertise for the execution of the SESAR 3 JU programme	Q4	2025	100 000	Specific contract under the framework contract ref. S3JU/LC/017-CTR – LOT 2	-
Op.16	4000	Airport expertise	Provision of airport expertise for the execution of the SESAR 3 JU programme	Q1	2024	250 000	Specific contract under framework contract	-
Op.17	4000	Airport expertise	Provision of airport expertise for the execution of the SESAR 3 JU programme	Q4	2024	250 000	Specific contract under framework contract	-
Op.18	4000	Airport expertise	Provision of airport expertise for the execution of the SESAR 3 JU programme	Q2	2025	250 000	Specific contract under framework contract	-
Op.19	4000	Professional Staff Associations	Provision of PSO's expertise to the DES in the field of Air Traffic Controllers' European Unions Coordination (ATCEUC)	Q4	2024	50 000	Specific Contract under Framework Contract S3JU/LC/012-CTR	-
Op.20	4000	Professional Staff Associations	Provision of PSO's expertise to the DES in the field of European Cockpit Association (ECA)	Q4	2024	50 000	Specific Contract under Framework Contract S3JU/LC/007-CTR	-

Ref.	Budget line(s)	Procurement area	Procurement description	Target signature date	Budget year	Total estimated budget (EUR)	Type of contract/ procedure	Comments
Op.21	4000	Professional Staff Associations	Provision of PSO's expertise to the DES in the field of European Transport workers Federation (ETF)	Q4	2024	50 000	Specific Contract under Framework Contract S3JU/LC/008-CTR	-
Op.22	4000	Professional Staff Associations	Provision of PSO's expertise to the DES in the field of International Federation of Air Traffic Controllers' Associations (IFATCA)	Q4	2024	50 000	Specific Contract under Framework Contract S3JU/LC/011-CTR	-
Op.23	4000	Professional Staff Associations	Provision of PSO's expertise to the DES in the field of International Federation of Air Traffic Safety Electronics Association (IFATSEA)	Q4	2024	50 000	Specific Contract under Framework Contract S3JU/LC/013-CTR	-
Op.24	4000	Professional Staff Associations	Provision of PSO's expertise to the DES in the field of Air Traffic Controllers' European Unions Coordination (ATCEUC)	Q4	2025	50 000	Specific Contract under Framework Contract S3JU/LC/012-CTR	-
Op.25	4000	Professional Staff Associations	Provision of PSO's expertise to the DES in the field of European Cockpit Association (ECA)	Q4	2025	50 000	Specific Contract under Framework Contract S3JU/LC/007-CTR	-
Op.26	4000	Professional Staff Associations	Provision of PSO's expertise to the DES in the field of European Transport workers Federation (ETF)	Q4	2025	50 000	Specific Contract under Framework Contract S3JU/LC/008-CTR	-
Op.27	4000	Professional Staff Associations	Provision of PSO's expertise to the DES in the field of International Federation of Air Traffic Controllers' Associations (IFATCA)	Q4	2025	50 000	Specific Contract under Framework Contract S3JU/LC/011-CTR	-
Op.28	4000	Professional Staff Associations	Provision of PSO's expertise to the DES in the field of International Federation of Air	Q4	2025	50 000	Specific Contract under Framework Contract S3JU/LC/013-CTR	-

Ref.	Budget line(s)	Procurement area	Procurement description	Target signature date	Budget year	Total estimated budget (EUR)	Type of contract/ procedure	Comments
			Traffic Safety Electronics Association (IFATSEA)					
Op.29	4000	Young Scientist Award	Price for Young Scientist Award (excluding travel costs)	Q4	2024	15 000	Prize Award	-
Op.30	4000	Young Scientist Award	Price for Young Scientist Award (excluding travel costs)	Q3	2025	15 000	Prize Award	-
Op.31	4000	Communication Operational	SESAR 3 Innovation Days 2024 (SIDs)	Q2	2024	100 000	Inter-institutional procurement (FWC CS2JU.2021.OP.01 - Lot 3)	To cover SIDs 2024
Op.32	4000	Communication Operational	Airspace World	Q4	2024	50 000	Inter-institutional procurement (FWC CS2JU.2021.OP.01 - Lot 3)	To cover WAC 2025
Op.33	4000	Communication Operational	SESAR 3 Innovation Days 2025 (SIDs)	Q2	2025	125 000	Inter-institutional procurement (FWC CS2JU.2021.OP.01 - Lot 3)	To cover SIDs 2025
Op.34	4000	Communication Operational	Aerodays	Q1	2025	30 000	Inter-institutional procurement (FWC CS2JU.2021.OP.01 - Lot 3)	To cover Aerodays 2025
Op.35	4000	Coordination with EASA	EASA SLA	Q1	2024	400 000	Service Level Agreement EASA - SESAR 3 JU	To cover 2024 activities
Op.36	4000	Coordination with EASA	EASA SLA	Q1	2025	300 000	Service Level Agreement EASA - SESAR 3 JU	To cover 2025 activities

Ref.	Budget line(s)	Procurement area	Procurement description	Target signature date	Budget year	Total estimated budget (EUR)	Type of contract/ procedure	Comments
Op.37	4000	Digital European Sky Programme	Programme Support (S3DSS)	Q1	2025	3 696 182	On-going Direct contract ref. S3JU-004-CTR	
Under administrative appropriations								
Ad. 01	2700	PR	Strategy and support	Q1	2024	50 000	Specific Contract under Inter-institutional procurement (FWC CS2JU.2021.OP.01 - Lot 1)	Social media, press and copyrighting support
Ad. 02	2700	PR	Digital communication	Q2	2024	90 000	Specific Contract Inter-institutional procurement (FWC CS2JU.2021.OP.01 - Lot 2)	Animations
Ad. 03	2700	Public relations (PR)	Events	Q1	2024	285 000	Inter-institutional procurement (FWC CS2JU.2021.OP.01 - Lot 3)	Visibility at aviation events and air shows, as well as external and internal SESAR 3 JU events
Ad. 04	2700	Web (budget line 2740)	Provision of web services	Q1	2024	125 000	Inter-institutional procurement (FWC CS2JU.2021.OP.01 - Lot 4)	Hosting, maintenance and content management

Ref.	Budget line(s)	Procurement area	Procurement description	Target signature date	Budget year	Total estimated budget (EUR)	Type of contract/ procedure	Comments
Ad. 05	2700	PR	Strategy and support	Q3	2024	50 000	Specific Contract 5 under Inter-institutional procurement (FWC CS2JU.2021.OP.01 - Lot 1)	Social media, press and copyrighting support
Ad. 06	2700	PR	Office of publications	Ad hoc	2024	5 000	Inter-institutional procurement (SLA)	Editorial, graphical work and printing
Ad. 07	2700	PR	Small procurement	Ad hoc	2024	10 000	Payment against invoices, purchase orders, direct service, supply contracts	Direct procurement for very-low-value items – items to be paid against invoices (very low procurements)
Ad. 08	2700	PR	Strategy and support	Q1	2025	70 000	Inter-institutional procurement (FWC CS2JU.2021.OP.01 - Lot 1)	Social media, press and copyrighting support
Ad. 09	2700	PR	Digital communication	Q2	2025	30 000	Inter-institutional procurement (FWC CS2JU.2021.OP.01 - Lot 2)	Animations
Ad. 10	2700	PR	Events	Q2	2025	350 000	Specific Contracts under Inter-institutional procurement (FWC CS2JU Lot 2)	Visibility at aviation events and air shows, as well as external and internal SESAR 3 JU events

Ref.	Budget line(s)	Procurement area	Procurement description	Target signature date	Budget year	Total estimated budget (EUR)	Type of contract/ procedure	Comments
Ad. 11	2100	Web (budget line 2740)	Provision of web services	Q1	2025	125 205	Inter-institutional procurement (FWC CS2JU.2021.OP.01 - Lot 4)	Hosting, maintenance and content management
Ad. 12	2700	PR	Office of publications	Q1	2025	5 000	Inter-institutional procurement (SLA)	Editorial, graphical work and printing
Ad. 13	2700	PR	Strategy and support	Q3	2025	180 000	Specific Contract under Inter-institutional procurement (FWC CS2JU.2021.OP.01 - Lot 1)	Social media, press and copyrighting support
Ad. 14	2700	PR	Small procurement	Ad hoc	2025	30 000	Payment against invoices, purchase orders, direct service, supply contracts	Direct procurement for very-low-value items – items to be paid against invoices (very low procurements)
Ad. 15	2100	ICT	Renewal of the Adobe licenses	Q4	2024	18 000	Purchase Order implementing FWC DI/07720 via DIGIT	Subject to the same conditions as today, unless the Adobe licenses are provisioned by EUROCONTROL based on a strategic decision
Ad. 16	2100	ICT	TESTA-NG	Q4	2024	40 000	Specific Contract implementing FWC DI/07820 via DIGIT	New FWC not awarded by DIGIT yet, hence referring to the existing FWC for now

Ref.	Budget line(s)	Procurement area	Procurement description	Target signature date	Budget year	Total estimated budget (EUR)	Type of contract/ procedure	Comments
Ad. 17	2100	ICT	NextSend	Q2	2024	1 000	Purchase Order, paid on invoice	Very low value
Ad. 18	2100	ICT	Renewal of the Adobe licenses	Q4	2025	19 000	Purchase Order implementing FWC DI/07720 via DIGIT	Subject to the same conditions as today, unless the Adobe licenses are provisioned by EUROCONTROL based on a strategic decision
Ad. 19	2100	ICT	TESTA-NG	Q1	2025	44 000	Specific Contract implementing FWC DI/07820 via DIGIT	New FWC not awarded by DIGIT yet, hence referring to the existing FWC for now
Ad. 20	2100	ICT	NextSend, EuroDNS, Reserve	Q2	2025	1 000	Purchase Order, paid on invoice	Very low value
Ad. 21	2100	ICT	Mobile Telephony services	Q3	2025	3 090	Specific Contract implementing inter-institutional procedure (EC FWC)	
Ad. 22	2300	Legal	Legal Services	Ad hoc	2024	20 000	Negotiated Procedure	-
Ad. 23	2300	Legal	Legal Services	Ad hoc	2025	20 000	Negotiated Procedure	Negotiated procedures without prior publication of a contract notice (Art. 168(5) FR) in case of need (Court case, need for external legal advice, etc.)

Ref.	Budget line(s)	Procurement area	Procurement description	Target signature date	Budget year	Total estimated budget (EUR)	Type of contract/ procedure	Comments
Ad. 24	2300	Data protection	Operational and legal support to Data Protection activities	Q1	2024	n.a.	New Framework Contract	-
Ad. 25	2300	Data protection	Operational and legal support to Data Protection activities	Ad hoc	2024	20 000	Specific Contract under Inter-institutional procurement (FWC led by SESAR 3 JU)	-
Ad. 26	2300	Data protection	Operational and legal support to Data Protection activities	Ad hoc	2025	69 500	Specific Contract under Inter-institutional procurement (FWC led by SESAR 3 JU)	-
Ad. 27	2300	Data protection	Register online, support and legal services	Q1	2024	4 000	Specific Contract under Inter-institutional procurement (FWC led by EU-Rail JU)	-
Ad. 28	2300	Data protection	Register online, support and legal services	Q1	2025	4 000	Specific Contract under Inter-institutional procurement (FWC led by EU-Rail JU)	-
Ad. 29	2100	Cyber and information security	Provision of Cyber and Information Security Services	Ad hoc	2024	150 000	Specific contracts under the framework contract	Provision of advisory services in the area of cyber-security, data protection and business continuity.

Ref.	Budget line(s)	Procurement area	Procurement description	Target signature date	Budget year	Total estimated budget (EUR)	Type of contract/ procedure	Comments
Ad. 30	2100	Cyber and information security	Provision of Cyber and Information Security Services	Q1	2025	150 000	Specific contracts under the framework contract	Provision of advisory services in the area of cyber-security, data protection and business continuity.
Ad. 31	2100	Cyber and information security	Provision of cybersecurity services	Q2	2025	16 000	Specific Contract implementing inter-institutional procedure (EC FWC)	
Ad. 32	2300	Quality Management	Provision of Quality, Information and Document Management Services	Q1	2024	650 000	Negotiated (following cancellation of call) or open procedure	New procedure following cancellation of procurement procedure for Lot 3 of call for tenders ref. S3JU/LC/006/CFT.
Ad. 33	2300	Audit	Supply of technical assistance services in the field of Audits and Controls (External Audit of the Annual Accounts 2024-2025)	Q2	2024	46 000	Specific contract implementing Framework Contract - Interinstitutional procedure	S3JU External Annual Audit
Ad.34	2000	Facility	Front and back-office reception services	Q4	2025	81 000	Specific Contract implementing FWC	
Ad. 35	2000	Facility	Works and repairs	Ad Hoc	2025	5000	Payment against invoices, purchase orders, direct service, supply contracts	

Ref.	Budget line(s)	Procurement area	Procurement description	Target signature date	Budget year	Total estimated budget (EUR)	Type of contract/ procedure	Comments
Ad. 36	1900	PR	Corporate events	Q2	2025	12 500	Low value procurement	
Ad. 37	1900	PR	Corporate events	Q4	2025	12 500	Low value procurement	
Ad. 38	1900	HR	Team Building	Q1	2025	25 000	Inter-institutional procurement (FWC EPSO-2023-OP-0003)	
Ad. 39	2100	ICT	Fixed Telephony services	Q3	2025	6 901	Specific Contract implementing inter-institutional procedure (EC FWC)	
Ad. 40	2300	Plants	Provision of plant maintenance services	Q1	2025	3 500	Negotiated procedure	Low value procedure
Ad. 41	2300	Quality Management	Provision of Knowledge Information and Data (KID) services	Q1	2025	150 000	Specific contract implementing Framework Contract - Interinstitutional procedure	
Ad. 42	2300	Quality Management	Provision of information and Quality Management Services	Q1	2025	162 500	Specific contracts under framework contract	Offers received in response to call for tender ref. S3JU-PN-2024-003 under evaluation
Ad. 43	2300	Audit	Supply of technical assistance services in the field of Audits and Controls (External Audit of the Annual Accounts 2024-2025)	Q2	2025	23 950	Specific contract implementing Framework Contract - Interinstitutional procedure	S3JU External Annual Audit

Annex III: Call for proposals – Full description

According to the Horizon Europe rules, and in order to protect Union interests, the right for joint undertaking to object to transfers of ownership of results or to grants of an exclusive licence regarding results should apply to participants. Therefore, the provisions set out in General Annex G to the Horizon Europe work programmes on the right to object apply generally. It should be noted that in accordance with the SBA and the MGA, the right to object applies also to participants that have not received funding from the JU and for the periods set therein.

1 Call HORIZON-SESAR-2025-DES-ER-03

1.1 Scope of the call

The third SESAR 3 JU Exploratory research call (HORIZON-SESAR-2023-DES-ER-03) under the DES will focus on disruptive technologies and innovative concepts that are in the early stages of development. The primary aim is to explore new ideas, concepts, methods and technologies that will help define future development activities in ATM aligned with the long-term vision of the Digital European Sky.

The ER3 call specifications are structured in two working areas (WA):

- **WA1 Fundamental research:** comprises the exploratory research activities necessary to develop emerging concepts, technologies, and methods from TRL0 to the level of maturity required to feed the applied research (i.e., TRL1) conducted by the SESAR 3 JU. This WA includes three topics, one per development priority identified in the ATM Master Plan for fundamental research **(i.e., FR)**:
    - WA1-1 covering development priority FR-01 ATM impact on climate change.
    - WA1-2 covering development priority FR-02 Digital flight rules.
    - WA1-3 covering development priority FR-03 Investigate quantum sensing and computing applied to ATM.

  A fourth topic covers any ATM/U-space fundamental research area not covered by the development priorities FR-1, FR-2 or FR-3.

- **WA2 Applied research:** comprises the exploratory research activities aiming to bridge the results of fundamental research (i.e., TRL1) and the higher maturity ATM research performed as part of SESAR 3 JU industrial research activities (i.e., TRL2). This WA includes two topics, covering two of the development priorities identified in the ATM Master Plan for applied research **(i.e., AR)**:
    - WA2-1 covering development priority AR-01 Research to help shape the future regulatory framework for a Digital European Sky.
    - WA2-2 covering development priority AR-03 Integration of the next generation aircraft for zero/low emission aviation.

  Applied research on U4 U-space services (development priority AR-2 “definition of U4 U-space services”) is not included. Since there are still substantial on-going activities on U-space in ER2 and IR2 call specifications cover the development of U3 U-space advanced services, the proposed approach is to first consolidate R&I results on U3 before launching activities exploratory research activities on U4 (U4 will be included in ER4 exploratory research call tentatively scheduled in Q1 2027).

1.2 General principles for the call

Proposals addressing the topics under this call shall consider the following general principles:

- Proposals shall identify and justify the link between the proposed research and the ATM Master Plan development priorities for exploratory research.
- For topic WA1-4 "fundamental research on other topics", proposals can address research elements that are beyond those covered by the ATM MP development priorities for exploratory research: the proposals must provide adequate background and justification to ensure clear traceability of the new research element(s) to the ATM Master Plan transformation levers and the ATM Master Plan vision.
- Proposals shall demonstrate their transformative potential for ATM and be focused on embryonic/emerging technologies or areas of knowledge.
- Proposals are not requested to address all R&I needs identified under a topic; proposals can pick-up a number of R&I needs described in the scope of each topic.
- Proposals shall describe (with adequate rationale) how the proposed SESAR solution(s) will contribute to the expected performance benefits by 2050 as documented in the ATM Master Plan.

Performance impact (KPA)	Unit	Reference year (2023)(*)	CP1 (up to 2030)	CP1 + Phase C	Phase D	Expected impact by 2050
Airspace capacity (en-route and TMA)	%	8.5 million flights(*)	+ 34 %	+ 60 %	+ 40 % + 80 %	+ 100 % + 140 %
Airspace capacity	%	17.9 million movements(**)	–	+ 15 %	+ 1 % + 5 %	+ 16% + 20 %
Environment (fuel reduction)	kg / flight	6 400	– 22	– 109	– 491	– 600
	%		– 0.3 %	– 1.6 %	– 7.7 %	– 9.3 %
Passenger time saving (departure punctuality)	minute / flight	18	–	– 0.9	– 6.1 – 8.1	– 7 – 9
Cost-efficiency (air navigation services cost reduction)	EUR / flight	1 077	– 26	– 164	– 54	– 209

*10.1 million actual flights generating an average delay of 1.82 min/flight (SOURCE: Performance Review Report (PRR) 2023). 8.5 million flights refers to the number of flights that the network could handle, offering a quality of service of 0.5 minutes of en-route ATFM delay per flight. This estimation is based on the PRR 2001 formula to convert traffic into capacity.
**IFR movements (arrivals and departures) at ECAC airports in 2023 (SOURCE PRR 2023).

Figure A1: Expected performance impact by 2050 (ATM Master Plan)

- The applicable target maturity levels for exploratory research are TRL1 (fundamental research) and TRL2 (applied research).
- Proposals can target higher maturity levels than those initially expected for fundamental research (TRL1) or applied research (TRL2). However, following the project handbook principles, the expected type of deliverables and content are driven by the target maturity level and not by the type of project or call. Intermediate TRLs (i.e., TRL3, TRL5) are not applicable.

- Proposals shall describe (with adequate rationale) how the proposed SESAR solution(s) will contribute to achieve automation level 4 as defined in the ATM Master Plan within a pre-defined scope and be able to revert to automation level 3 or lower outside of this scope (when a task becomes too complex for automation to handle), or how the proposed SESAR solution(s) will effectively operate in such an environment.

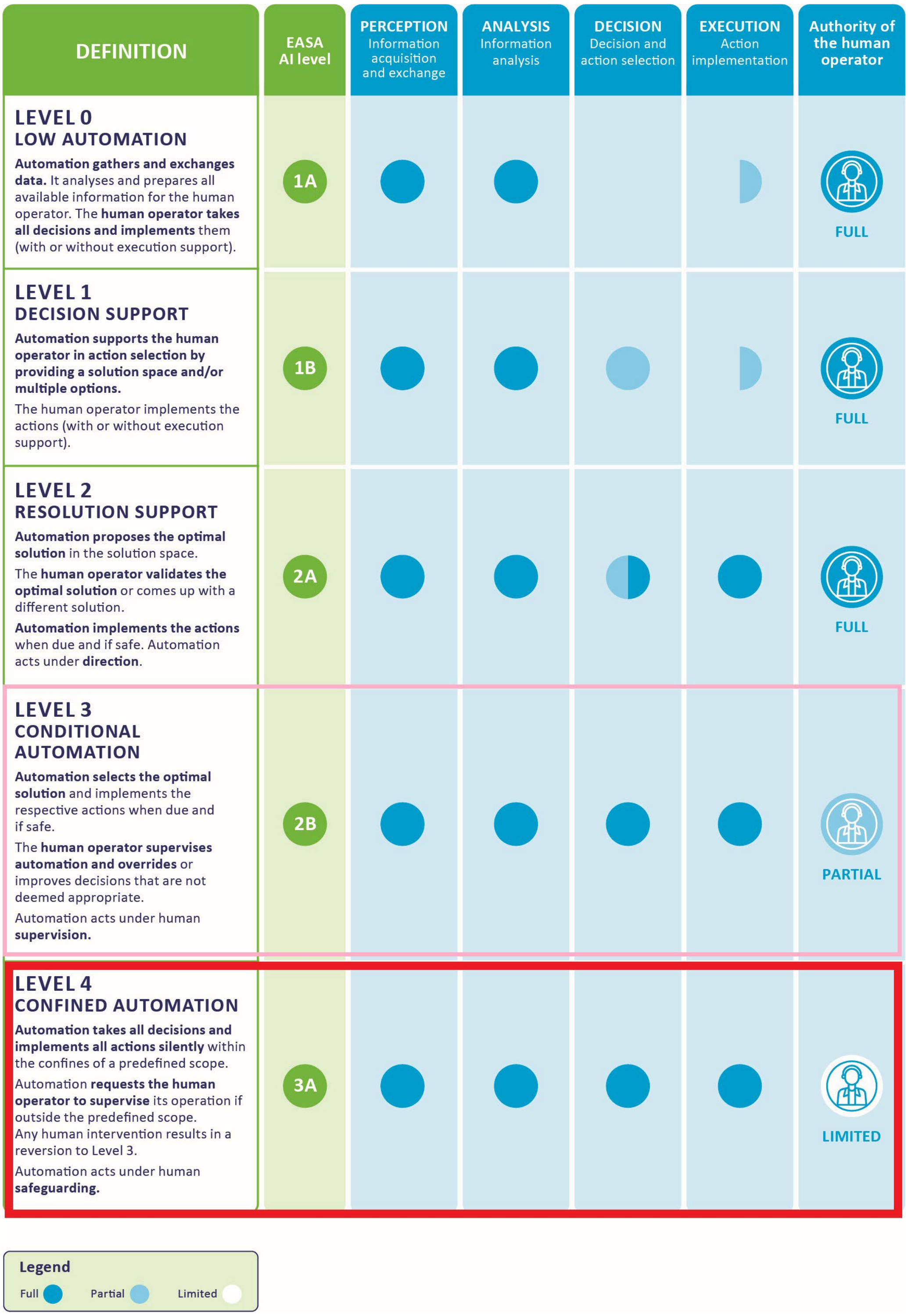

Figure A2: Automation levels (ATM Master Plan)

- ER1 and ER2 projects are already in execution: proposals shall take care of avoiding duplication in terms of scope with research elements under ER1/ER2 or justify the complementarity if this happens.
- The type of deliverables and content that are required as evidence for successfully achieving the target maturity level depends on the type of SESAR solution (ATM solution / Technological solution).
- Proposals shall align to the requirements included in the SESAR project handbook. Deviations are possible when justified (e.g., the expected technical deliverables per TRL in the project handbook may not be fully applicable due to the nature and/or objectives of the research).
- The projects awarded in this call should follow the EU open science principles, making their results and research databases publicly available. In case there are deliverables planned as confidential / restricted access in the proposal, a justification must be provided (for example based on the need to protect intellectual property rights) and complementary measures must be planned to ensure an adequate level of dissemination, e.g. scientific publications with GOLD access level, additional public deliverables containing the non-sensitive content, etc.

1.3 General conditions for the call

Unless otherwise stated, the call follows the general conditions laid down in the General Annexes to the Horizon Europe Work Programme for 2023-2025, adopted by the European Commission[41].

Topic	**Type of actions**	Budget (million EUR) for 2025	**Maximum expected EU contribution per project (million EUR)**[42]
Opening: 1 April 2025 Deadline([43]): 16 September 2025			
HORIZON-SESAR-2025-DES-ER-03-WA1-1	Research and innovation action (RIA)	10	1
HORIZON-SESAR-2025-DES-ER-03-WA1-2			1
HORIZON-SESAR-2025-DES-ER-03-WA1-3			1
HORIZON-SESAR-2025-DES-ER-03-WA1-4			1
HORIZON-SESAR-2025-DES-ER-03-WA2-1		14	2
HORIZON-SESAR-2025-DES-ER-03-WA2-2			2
Overall indicative budget		24	

[41] European Commission Decision C(2024) 2371 of 17 April 2024.

[42] Nonetheless, this does not preclude the submission or the selection of a proposal requesting a different amount.

[43] The Executive Director responsible may delay the deadline(s) by up to 2months. All deadlines are at 17.00.00 Brussels local time.

Type of conditions	Information on the conditions
Admissibility conditions	The conditions are described in General Annex A to the Horizon Europe work programme for 2023–2025.
Eligibility conditions	The conditions are described in General Annex B to the Horizon Europe work programme for 2023–2025. This call is subject to restrictions for the protection of European communication networks.
Financial and operational capacity and exclusion	The criteria are described in General Annex C to the Horizon Europe work programme for 2023–2025.
Award criteria	The criteria are described in subsection 1.3 below.
Documents	The documents are described in General Annex E to the Horizon Europe work programme for 2023–2025.
Procedure	The procedure is described in General Annex F to the Horizon Europe work programme for 2023–2025. The following exceptions apply: • the evaluation committee may be composed partially of representatives of EU institutions and agencies (internal experts).
Legal and financial set-up of the grant agreements	The rules are described in General Annex G to the Horizon Europe work programme for 2023–2025. The following exceptions apply. 1) Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025).[44]. 2) Beneficiaries will be subject to the following additional dissemination obligations: ○ beneficiaries must make proactive efforts to share, on a royalty-free basis, in a timely manner and as appropriate, all relevant results with the other grants awarded under the same call; ○ beneficiaries must acknowledge these obligations and incorporate them into the proposal, outlining the efforts they will make to meet them, and into Annex I to the grant agreement. 3) Beneficiaries will be subject to the following additional exploitation obligations: For the purpose of complying with the objectives set in Council Regulation (EU) 2021/2085, the SRIA and the European ATM Master Plan; ○ beneficiaries must make available for reuse under fair, reasonable and non-discriminatory conditions all relevant results generated, through a well-defined mechanism using a trusted repository;

[44] This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under 'Simplified costs decisions' or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/ls-decision_he_en.pdf

	○ if the purpose of the specific identified measures to exploit the results of the action is related to standardisation, beneficiaries must grant a non-exclusive licence to the results royalty-free; ○ if working on linked actions, beneficiaries must ensure mutual access to the background to and to the results of ongoing and closed linked actions, should this be necessary to implement tasks under the linked actions or to exploit results generated by the linked actions as defined in the conditions laid down in this biannual work programme and in the call for proposals; ○ beneficiaries must acknowledge these obligations and incorporate them into the proposal, outlining the efforts they will make to meet them, and into Annex I to the grant agreement.
Other conditions	The maximum project duration is 30 months, including a 6-month period at the end of the project life cycle to undertake communications, dissemination and exploitation activities in relation to the research results.

1.4 Award criteria

Type of actions	**Excellence** *(The following aspects will be taken into account, to the extent that the proposed work corresponds to the description in the work programme)*	**Impact**	**Implementation**
Research and innovation actions (RIA)	1. Clarity and pertinence of the proposal: degree to which the objectives, scope and requirements set out in the call material are well understood and fully addressed. 2. Soundness of the proposed methodology for developing the SESAR solutions, including the underlying concepts, models, assumptions and interdisciplinary approaches. This criterion also includes appropriate consideration of the integration of a gender dimension into R&I content and the quality of open science practices[45], including sharing and management of research outputs and	1. Credibility of the pathways to achieve the expected outcomes and impacts specified in the call material. 2. Suitability and quality of the measures in terms of maximising expected outcomes and impacts, as set out in the dissemination and exploitation (D&E) plan, including communication activities.	1. Quality and effectiveness of the work plan, and assessment of risks, and appropriateness of the effort assigned to work packages, and the resources overall. 2. Capacity and role of each participant, and the extent to which the consortium as a whole brings together the necessary expertise.

[45] See EU's open science policy (https://ec.europa.eu/info/research-and-innovation/strategy/strategy-2020-2024/our-digital-future/open-science_en).

	engagement of citizens, civil society and end users where appropriate. 3. Level of awareness of the state of the art: degree to which the proposal demonstrates knowledge of current operations and relevant previous R&D work (both within and outside SESAR), explains how the proposed work will go beyond the state of the art and demonstrates innovation potential.		

1.5 Specific conditions and description of topics for each work area

1.5.1 Work Area 1: Fundamental research

Specific conditions for WA1	
Expected EU contribution per project	The SESAR 3 JU estimates that a maximum EU contribution of EUR 1.00 million would allow the outcomes to be addressed appropriately. Nonetheless, this does not preclude the submission or the selection of a proposal requesting a different amount.
Indicative budget	The total indicative budget for this work area is EUR 10.00 million.
Type of actions	Research and innovation action (RIA)
Procedure	The procedure is described in General Annex F to the Horizon Europe work programme for 2023–2025.

1.5.1.1 Topic HORIZON-SESAR-2025-DES-ER-03-WA1-1: ATM impact on climate change

Aviation contributes significantly to greenhouse gas emissions and other pollutants that impact environment and climate change. Understanding the exact magnitude of this impact, as well as the mechanisms involved, is essential for developing effective ATM optimisation strategies that can be automated, and which consider the total impact on the climate of each flight. Accurate scientific data is necessary to develop evidence-based optimisation algorithms and rules aimed at reducing the environmental impact of aviation. Without comprehensive research, it is challenging to implement measures that effectively balance e.g. the CO_2 vs non-CO_2 impacts.

Expected outcomes

To significantly advance the following development priority:

- FR-1 **ATM impact on climate change**.

Specific requirement for this topic

Any proposal addressing non-CO_2 impacts shall take into consideration on-going work under the "Aviation Non-CO_2 Expert Network (ANCEN)" and feed into the community work. ANCEN goal is to facilitate a coordinated approach across a wide range of relevant stakeholders (e.g., scientific community, academia, OEMs, aircraft operators, fuel producers, ANSPs, NGOs, regulators, analysts and policymakers) to provide objective, timely, common and credible technical advice. This work can inform, where relevant, policy discussions on the development, agreement and implementation of effective action within Europe and internationally to mitigate the overall climate impacts caused by aviation (CO_2 and non-CO_2 emissions).

Scope (R&I needs)

1. **Noise and air quality pollutants**

Research aims at increasing the body of knowledge on the impact of ATM on areas such as noise and air quality pollutants (nitrogen oxides (NO_X), particulate matter (PM), volatile organic compounds (VOCs), sulphur dioxide (SO_2), carbon monoxide (CO) and unburnt hydrocarbons (HC)). Research aims at better understanding the ATM environmental impacts beyond greenhouse emissions (CO_2 and non-CO_2 aviation emissions). Research shall consider the new types of aircraft propulsions, new aircraft configurations and new propulsion fuels (e.g., hydrogen), whose impact on noise and air quality need to be researched; regarding the new aircraft types, research shall consider the work performed under Clean Aviation programme (www.clean-aviation.eu).

Research shall also consider the consideration of new entrants (e.g., higher airspace operations (HAO). An increasing number of rocket and space vehicle launches are planned, which clearly will significantly impact the population in the neighbourhood of concerned launch sites (e.g., Grotaglie airport) with massive noise exposure and potentially as well with particle and gaseous pollutants relevant for local air quality. Research shall also pay attention to the social acceptance aspects of such launch and re-entry activities.

2. **Atmospheric physics for aviation (extreme weather events)**

Research aims at increasing the body of knowledge on the physics of the atmosphere, to better understand and reliably quantify the effect of climate change on future trends regarding severe weather events (e.g., severe convective storms, heatwaves, dust storms, etc.) and weather hazards (e.g., clear air turbulence, hail, low-level windshear, extreme wind, heavy precipitations, in-flight icing conditions, etc.). Research shall propose innovative methods to model the effects of climate change on these future trends with high reliability and accuracy over the next decades. The objective is to improve the ATM system climate resilience and adaptation and minimise negative impacts on ATM (e.g., airport closures or significant reductions in airport capacity (with knock-on effects on the network)). Results will facilitate the definition of a climate change adaptation strategy for aviation and decision-making by ANSPs, airports and the other aviation stakeholders, covering from short to long-term (e.g., ensuring that ATM short-term induced decision will not jeopardise long-term ATM resilience and sustainability). The research should consider the challenges for accurate prediction that may result from changes to weather patterns arising from global warming in the short to medium-term.

Research shall elaborate a thorough state of the art review to evaluate the progress made atmospheric physics for aviation (extreme weather events) by previous research or on-going research within SESAR or outside SESAR. Note that there is on-going work under project AEROPLANE, which is reviewing the effect of heatwaves on aeroplanes take-off performance.

Research shall consider the knowledge gaps reported in the "ICAO Committee on Aviation Environmental Protection (CAEP) aviation and climate change factsheet[46]", the EASA "European aviation environmental report 2022[47]" and the EASA Scientific Committee Annual Report 2023[48].

3. Multi-scale multi-pollutant air quality systems (CO_2 and non-CO_2)

Research aims at developing potential solutions for the evaluation of the impact that the air traffic regulation policy options can have on the environment and climate. The proposed solutions should be able to follow the evolution of aircraft emissions (e.g., CO_2 and non-CO_2) in the atmosphere on both the global/regional scale (e.g., transport of pollutants from the troposphere to the stratosphere, impact onto the radiative properties of the atmosphere, ozone production, etc.), and on the local scale (e.g., impact close to an airport area during landing and take-off phases). The main area of applicability of such a solution is to support the aviation community in estimating the extent of the environmental impacts that current and future air traffic movements might have. An effective multi-scale air quality system shall address all phases of flight, starting at the strategic phase and including the post-operations phase. Research may leverage the potential of AI technologies to provide accurate and real time estimations of trajectories and impacts (using all available information and/or predictions of atmospheric status and weather) in order to assess the relevance of new indicators. Proposals shall demonstrate the relevance of the proposed approach and scope for ATM.

Research shall elaborate a thorough state of the art review to evaluate the progress made on multi-scale multi-pollutant air quality systems (CO_2 and non-CO_2) by previous research or on-going research within SESAR (e.g., project CREATE) or outside SESAR.

Coordination with the "Aviation Non-CO_2 Expert Network (ANCEN)[49]" is required to focus on priority research gaps that need to be addressed to develop robust decision-making capabilities.

4. Development of the environmental performance-monitoring toolkit (CO_2 and non-CO_2) to include new entrants

There is a need to further develop the set of European environmental impact assessment tools, to analyse, inter alia, the integration of new entrants into the future ATM system and the overall environmental benefits and impacts (not only in terms of CO_2 but also non-CO_2) they will have. This element covers the expansion of the ATM aircraft performance models (on emissions and noise) to include new entrants and new aircraft types/fuels. It involves research into the impact on the environment of new fuels and/or new aircraft types (hydrogen, electric, sustainable aviation fuels, new hyper-/supersonic aircraft (with consideration of sonic booms)), including developing new models to assess the impact that ATM operational changes may have when these aircraft are introduced into the traffic mix, and exploring the boundaries for change to avoid negative effects on operational performance and environment (i.e., sensitivity analysis). Research shall also consider the potential of new entrants to re-shape the ATM network (e.g., new hubs driven by the new re-fuelling needs and stations, new airspace needs, etc.).

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[46] www.icao.int/environmental-protection/Documents/Factsheet%20Business%20and%20Economics%20Final.pdf

[47] https://www.easa.europa.eu/eco/sites/default/files/2023-02/230217_EASA%20EAER%202022.pdf

[48] https://www.easa.europa.eu/en/domains/research-innovation/easas-scientific-committee-scicomm

[49] https://www.easa.europa.eu/en/research-projects/nonco2

Research should include the development of methodologies to assess the environmental and societal impact of U-space-enabled drone operations, including the identification of all potential impacts (e.g., visual pollution, noise over populated areas, intrusion into privacy, risks to wildlife (migrating birds, nesting areas, etc.)). In addition, research shall also address higher airspace operations (HAO), especially during launch and re-entry operations. Due to the complexity and diversity of environmental impacts, particular attention needs to be paid to the analysis of trade-offs, between environmental impacts, but also possibly with other performance areas.

Research shall consider the required coordination with EASA (since the Agency is already working on this research topic) to ensure complementarity on the research objectives and approach.

5. Validation of novel metrics in support of environmental impact assessment in ATM and U-space (noise, emissions CO_2 and non-CO_2)

The collaborative management of environmental impacts and the implementation of strategies to reduce them require the development of indicators/metrics that will enable, on one hand, all ATM / U-space decision-makers to make informed decisions at different levels and to communicate on ATM / U-space community efforts towards environmental sustainability. Research aims at developing and validating new environmental metrics for use in R&I and/or operations. The areas for development include:

- The use of extended projected profile (EPP) data for environmental performance assessment.
- The development of meaningful operational proxies that can support ATM / U-space decision making in ATFM, ATC and drone operations, development of methodologies for providing an accurate estimation of CO_2 and non-CO_2 impacts (including noise) with minimal input data (e.g., based only on surveillance data combined with flight plan data etc.). When sufficient input data is available, research may leverage the potential of AI technologies to make generate more accurate predictions or indicators.
- The research can also investigate the adaptation to ATM of software and methodologies currently in use by aircraft operators and service providers to optimise their environmental performance; also, the research should consider its applicability for U-space / drone operations.

Note that research has been performed or is on-going under projects CLAIM[50] or under initiatives such as Aviation Non-CO_2 Expert Network (ANCEN)[51] that should be considered to identify synergies and avoid duplication on this field.

6. Integrated platforms for the nowcasting and forecasting of multiple atmospheric hazards

This research aims at developing integrated platforms to incorporate predictions of atmospheric hazards (e.g., SO_2 contaminants, severe weather situations such as deep convection and extreme weather and climate hotspots potentially contributing to global warming, etc.). The focus is to enhance the situational awareness of all stakeholders in case of multiple hazard crisis by facilitating the transfer of required relevant information to end-users, presenting such

[50] https://www.claim-project.eu/

[51] https://www.easa.europa.eu/en/research-projects/nonco2

information in a user-friendly manner to ATM / U-space stakeholders, ultimately anticipating severe hazards and fostering better decision-making. Research may address:

- Extension of nowcasting models of SO_2 in 1D (values for a given location) to 2D (lat-long) and 3D and nowcasting products for dust, ash, volcanic aerosol and precursors and smoke.
- The consideration of additional observations (e.g., radar, satellite, sensors on board the aircraft) to better characterise the weather extremes and enhance the quality of the extreme weather nowcasting.
- The integration of space weather and climate change in the new MET services.
- The application of artificial intelligence or deep learning models based on recurrent networks could be used to better predict weather phenomena.
- Address potential human operator decision support systems able to import and process the meteorological forecasts and to adapt tactical arrival and departure scheduling to changing extreme weather conditions.
- Target airport, TMA and en-route operating environments and the potential use by different stakeholders (e.g., Network Manager, ANSPs (flow management and air traffic control positions), airports, airlines (dispatchers and pilots), etc.).
- Address the assessment of potential benefits in terms of capacity, efficiency, safety, predictability, and resilience.
- The inclusion of weather phenomena impact expected to affect U-space and drone operations into the now/forecasting integrated platforms.

Research shall consider the output of project ALARM. Note that there is on-going work on this research element under project KAIROS.

7. Contrails

The research aims at enhancing the methodology for detecting and recognizing aviation-induced contrails. This could be achieved through the utilization of deep learning models for image recognition on satellite data, as well as incorporating insights from physics sciences to model the evolution of linear contrails into cirrus clouds. The goal is to predict the formation of aviation-induced contrails, quantify their associated radiative forcing and their overall climate impact. It is important to consider previous/on-going work (projects E-CONTRAIL, CONTRAILNET, CICONIA), which used deep learning ML models and numerical weather prediction (NWP). In addition to these efforts, predicting contrails, especially persistent ones, hinges on atmospheric humidity. However, significant challenges remain today. To address those, research should focus on extending and enhancing humidity measurement techniques and on developing sophisticated numerical weather modelling approaches to enhance the accuracy of humidity and therefore of the contrail predictions. Research shall aim at quantifying the uncertainty in the prediction of contrails and the assessment of their impact on the climate to support inform operational decision-making.

In addition, the research should address the phenomenon of embedded contrails. These contrails form under specific conditions when aircraft fly through pre-existing cirrus clouds, resulting in contrails becoming embedded within those cloud layers. Despite their significance, our understanding of how embedded contrails impact the radiative forcing of natural cirrus clouds remains limited—an unquantified non-CO_2 effect of aviation. These embedded contrails have the potential to alter the cloud optical thickness (COT) of existing cirrus, potentially shifting their climate impact from net warming to net cooling. To advance the knowledge in this area, note that there is on-going work conducted by project AEROPLANE, which detected embedded contrails by analysing individual aircraft locations from aircraft position datasets and correlating them with height-resolved observations obtained from spaceborne light detection and ranging (LIDAR) and radar instruments. Research is also needed on contrails that are embedded in another contrail generated by an aircraft that flew in the area before, as well as on overlapping contrails produced by different aircraft.

The observation and identification of contrails play a crucial role in supporting contrail prediction. As the number of observational sensors increases, we gain the ability to correlate contrail occurrences with other relevant data, creating large databases that can be used for training machine learning (ML) models for contrail prediction. These observational means include in-situ measurements (like IAGOS, MOZAIC), geostationary satellites offering a global perspective, low orbit satellites providing more detailed data from low earth orbit, ground cameras which capture contrail events with higher resolution for specific locations and LIDAR, on satellites, aircraft or ground-based installations. In particular, but not exclusively, the research should explore the extended use of ground cameras and LIDARs for supporting contrail observation and identification tasks.

1.5.1.2 Topic HORIZON-SESAR-2025-DES-ER-03-WA1-2: Digital flight rules

The European ATM MP proposes a vision for a highly automated European ATM environment in accordance with the GATMOC. The objective of this research topic is to identify the related evolution of the ICAO ATM framework. This includes the introduction of a new type of flight rules that leverage advanced technologies to complement the current VFR/IFR paradigm. In addition, potential evolutions of the PANS OPS and PANS ATM documents may also be addressed.

Digital flight rules are anticipated to make extensive use of new technologies to enable uncrewed machines to operate safely amongst more traditional aviation. In addition, it is possible that technologies needed to support digital flight rules may provide benefits to crewed aviation. It is also anticipated that visual flight rules (VFR) and instrument flight rules (IFR) will continue, with digital flight rules acting as a new rule concept allowing more flexible operations than IFR, while making use of technology to overcome the shortcomings of VFR, such as weather impact and conspicuity.

Expected outcomes

To significantly advance the following development priority:

- FR-2 **Digital flight rules**.

Scope (R&I needs)

The following aspects are in scope:

- Evolution of ICAO Annex II (Rules of the Air):
  This concept builds on previous SESAR research for the integration of IFR RPAS integration in airspace A-G, where the ICAO Annex II responsibility to exercise on-board vigilance to avoid collisions is fulfilled by using CDTI traffic information instead of the traditional out-the-

window vigilance used by crewed aircraft. The objective is to analyse how previous research performed in SESAR 2020 PJ.13, PJ.13-W2 and ongoing project IRINA and provide foundational conceptual work to support the development and validation of a new flight rules concept (“digital flight rules”) to complement VFR and IFR, to be applied in environments where all aircraft are equipped with cooperative surveillance.

The new rules should be applicable to certified aircraft, crewed or uncrewed, as a complement IFR and VFR to allow the use a certified on-board system to perform:

- The equivalent of the out-the-window vigilance required for all aircraft by Annex II, similar to what has been proposed by previous SESAR research for IFR RPAS, but now applicable to equipped crewed and uncrewed aircraft, VFR or IFR.
- The manoeuvres required to remain well clear as per the right-of-way rules in Annex II that IFR and VFR pilots do in current operations when flying in an airspace where ATC does not provide a separation (i.e., in airspace C to G for VFR aircraft and airspace F and G for IFR aircraft)[52].

It is anticipated that digital flight rules will initially be applied only in a cooperative environment; the research should perform an initial analysis on whether in some cases on-board sensors for the detection of non-cooperative traffic may be required to support the safety case (e.g., this might be a requirement for uncrewed aircraft).

Digital flight rules should be compatible with both VFR and IFR and should provide support to crews that need to manoeuvre in accordance with the Annex II right-of-way rules (e.g., with a remain-well-clear system providing guidance for horizontal manoeuvring as per ED-271). Aircraft flying with digital flight rules would not have to maintain visual meteorological conditions (e.g., minimum visibility, distance from clouds, etc.). The research should describe the full operational concept and analyse how ICAO Annex II (rules of the air) and annex XI (ATS services, including flight planning aspects and appendix 4 – airspace classification) would need to evolve to allow this new concept. The research should also perform an initial assessment of the human performance aspects for both on-board pilots and remote pilots.

- Evolution of the overall ICAO framework to support a highly automated ATM environment

  The objective is to analyse the potential need for evolution other ICAO Annexes and documents (e.g., Annex 11 (Air Traffic Services), PANS OPS (doc. 8168), PANS ATM (Doc. 4444), Manual on ATCO competency-based training and assessment (Doc 10056), airworthiness and certification material, Annex 10 “aeronautical communications”, ICAO doc. 9771 "Manual on Collaborative Air Traffic Flow Management”, etc.) to allow the implementation of the highly automated vision put forward by the European ATM Master Plan at a global level. The research should consider the potential impact of the evolution of the role of the human operator in the ATM system required to achieve the MP vision. Analysing the changes to the ICAO documentation that might be required to cover the possibility that the functions that are allocated to the controller in the current text be performed by a certified ATC ground system instead of by the human operator, considering,

[52] Note that in airspace D and E, IFR aircraft must follow their IFR ATC clearance, which provides separation from all aircraft (VFR or IFR) in class A-C, and from IFR aircraft in class D and E. In airspace D and E, VFR aircraft are not subject to ATC clearance, while IFR aircraft are subject to ATC clearance and the clearance provides separation from other IFR aircraft but not with VFR aircraft.

for example CPDLC being handled on the ground side by the ATC system instead of the human operator, automatic delivery of ATC clearances by the ATC ground system without prior validation by a human operator, the move from voice to CPDLC as primary means of communication, etc.

1.5.1.3 Topic HORIZON-SESAR-2025-DES-ER-03-WA1-3: Investigate quantum sensing and computing applied to ATM

This topic focuses on exploring the potential applications of quantum sensing and computing within ATM (e.g., cybersecurity, queue management, etc). Quantum computing, a rapidly emerging technology, promises to revolutionise the computing landscape with its potential for high-speed and high-capacity data processing. In the context of ATM, quantum computing could significantly enhance the service-oriented architecture, improving efficiency and accuracy in air traffic control and management. This development priority aims to position ATM to fully leverage the advancements in quantum technology, ensuring that the sector stays at the forefront of technological innovation. It will involve studying the potential benefits and challenges of integrating quantum sensing and computing into ATM and developing strategies to effectively implement this technology.

Expected outcomes

To significantly advance the following development priority:

- FR-3 Investigate **quantum sensing and computing** applied to **ATM.**

Scope (R&I needs)

1. **Quantum computing (QC) applications in ATM**

   Quantum computing is a domain that integrates computer science, physics, and mathematics. Quantum computing’s ability to perform complex calculations at higher speeds than classical computing opens new opportunities for solving complex problems (as ATM related NP-hard problems coming from ATM (e.g., large-scale trajectory planning, airspace configuration optimization, etc.)) in real-time.

   It is acknowledged that quantum computers are not yet widely available. The objective of this research element is to explore the advantage of quantum computing in ATM. It is not expected that research will write quantum algorithms or make use of quantum machines. Quantum annealing is also in scope as a short-term, high-yield, low-risk method to quantise existing optimisation algorithms.

   Research aims at exploring how quantum computing could be applied in air traffic management and how it could impact ATM. Potential (and non-exhaustive) applications include:

   - Trajectory optimisation: classical computing methods can find it challenging to compute the most efficient trajectory in real time, especially when considering that flights operate in a very dynamic environment subject to many variables (e.g., air traffic restrictions, weather conditions, changing fuel prices, etc.). Quantum computing could handle multidimensional optimisation problems with higher speed and accuracy than classical computing. These algorithms could help airspace users to identify the most energy-efficient and time-effective trajectories, significantly reducing operational costs and environmental / societal impact.

- Traffic flow optimisation: quantum computing could help optimising flight schedules and flight plans, and therefore to smoother traffic demand, traffic flows and potential regulations in capacity constrained scenarios. By optimising traffic flows, it could help reducing delays (e.g., ATFCM, drone delivery, etc.) and making a better use of available capacity.

- Emergency and contingency management: in emergency situations, an efficient and on-time decision-making is crucial. Thanks to its ability to simulate a high number of potential scenarios in a fraction of the time required by classical computing, quantum computing could help defining the best possible strategy to manage an emergency and minimise risk to passengers, flight crew, and aircraft.

- Separation management: quantum computing could analyse huge datasets from (e.g., radar, satellite, transponder data, etc.) in real time, to mitigate the risk of collisions and support improving sequencing and spacing and thus more effectively managing an increasingly congested airspace.

- Improvement of network impact assessment (NIA) functionalities towards optimiser capabilities, to provide performance-driven dynamic airspace configurations (DAC) and optimised DCB solutions.

- Simulation infrastructure: quantum computers could be used to train deep learning models significantly faster than classical computers, leading to breakthroughs in areas like natural language processing and image recognition.

- Machine learning and artificial intelligence: quantum computing could improve and accelerate machine learning algorithms by solving certain optimisation and pattern recognition tasks more efficiently. Quantum machine learning might lead to improvements in data analysis, pattern recognition, performance assessment and optimization problems. Research could also explore the interfacing of quantum programs with existing models/simulators, in order to speed up the latter.

- Reinforcement learning: quantum computing could be applied to accelerate the agent's learning cycle, so the reinforcement learning process converges faster to a stable trained agent.

- Climate modelling: quantum computers could resolve complex climate models with greater precision, helping to understand climate change patterns, weather forecasting, and environmental impact assessments.

- C-UAS detection and identification - timely, quasi-immediate detection and identification of drone around sensible ground infrastructure could be handled thanks to the QC capacity. The classification of this drone (friendly, erroneous or malicious) could by identified and appropriate counter measure selected.

Depending on the proposed use case(s), research shall analyse which quantum technologies / algorithms are applicable / relevant.

2. Post-quantum cryptography in ATM

Quantum computing also poses challenges in ATM as quantum capabilities could potentially break traditional encryption methods. Although quantum computers capable of breaking current encryption algorithms are not yet developed to their maximum expected capabilities, the first operational quantum computers are being deployed world-wide. The EU needs to anticipate the maturing of quantum computers and start developing transition strategies towards a quantum-safe digital infrastructure now. The Commission has been funding research and development post-quantum cryptography[53] for over a decade, recognizing the potential threat quantum computing poses to present public key cryptography.

In the short-term, post-quantum cryptography (PQC) is considered to be the most promising approach to make communications and data resistant to quantum attacks. PQC allows for a swift transition to higher protection levels to secure against a cryptanalytic attack by quantum computers. In a next step, a limited scope quantum network could be used to provide perfect forward secrecy without reliance on any asymmetric algorithms (including PQC) based on Quantum Key Distribution (QKD), which could potentially be expanded to a fully-fledged quantum communication network.

The objective of the research must be to assess the cyber-security/cryptographic needs in ATM with a sense of priority, including both the ground-ground and air-ground segments, and define a short-term roadmap for introducing PQC (phase-in and hybridization) to secure the ATM infrastructure. The project must leverage previous PQC research and consider how it may apply to ATM rather than start from a clean-sheet approach. Proposals on this topic must demonstrate awareness of the European ATM communications infrastructure. The research may optionally explore how ATM may transition to QKD (e.g., as a user of the European Quantum Communication Infrastructure (EuroQCI)).

3. Quantum sensing applications

The objective of the research is to explore how quantum sensing could be applied for air navigation of crewed aircraft and drones, for example to:

- Provide high-performing alternative position, navigation and timing (A-PNT), addressing in particular resilient high-precision inertial navigation that is usable on all phases of flight. Recent geopolitical events have demonstrated the limitations of relying on satellite navigation. Indeed, while global navigation satellite systems (GNSS) including Galileo and the European geostationary navigation overlay service (EGNOS), are usually considered as suitable technologies for providing position, navigation, and timing (PNT) information as required, they can be subject to local (e.g., interference, spoofing, jamming) or global (ionospheric issues, system fault) outages, and it also presents service limitations in those areas where there is limited sky visibility. With the objective of having a back-up solution for GNSS as the source of PNT in the situations above, several potential technological solutions have been or are being developed to provide alternate position navigation and timing (A-PNT). While classical inertial sensors can provide the bandwidth and range, they do not provide sufficient accuracy for approach and landing. It is expected that the integration of quantum sensors into navigation systems could cover this gap, achieving high accuracy in autonomous positioning and increase resilience of trajectory based operations (quantum sensors do not refer to any external land- or satellite-based navigation infrastructure).

[53] https://www.enisa.europa.eu/publications/post-quantum-cryptography-integration-study

- Impact on datalink communications.
- Etc.

Proposals may address alternative applications of quantum sensing to ATM provided adequate background and justification is provided.

1.5.1.4 Topic HORIZON-SESAR-2025-DES-ER-03-WA1-4: Fundamental research for other topics

Expected outcomes

Fundamental research is typically curiosity-driven and explores new and innovative research areas for air traffic management (ATM), which are at TRL0. The objective is to bring new knowledge encouraging scientists to develop innovative ideas, concepts, emerging technologies, methods, and theories that explore the current boundary of knowledge on ATM/U-space and that have potential for the evolution of the future air traffic management / U-space system. Exploration of the potential benefits of the application of interdisciplinary methods is considered positive and in scope.

Scope (R&I needs)

The scope under this topic covers any ATM/U-space research area not covered by the development priorities for fundamental research (FR-1, FR-2 or FR-3) described in previous topics.

The proposals shall demonstrate their innovation / breakthrough potential, justify how the scope of the proposed research is aligned to the ATM Master Plan vision and how the expected outcomes will contribute to one or more of the five key transformation levers described in the ATM Master Plan (see Figure 4).

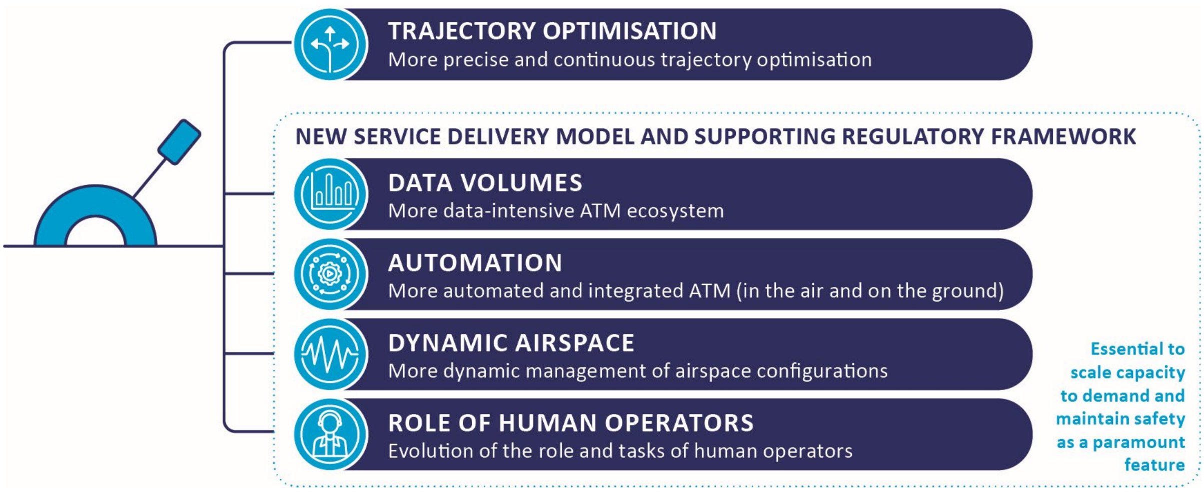

Figure A3: ATM Master Plan – transformation levers

The five transformation levers are described in the ATM Master Plan as follows:

- **Trajectory optimisation**: the proposed research shall contribute to guarantee a systematic, continuous, and precise optimisation of all aircraft trajectories throughout their lifecycle, from planning to execution, from gate to gate and within the context of congested airspace.

- **Data volumes**: the proposed research shall contribute to collect and process large volumes of data (e.g., aircraft performance characteristics, user preferences, real time traffic information and meteorological information throughout the network, etc.). Increased real-time sharing of secure and trusted data will enable airborne and ground systems and actors to stay interconnected and share the same situational awareness.

- **Automation**: the proposed research shall contribute to realise an effective teaming up of human operators and systems (i.e., human-machine teaming), which will be necessary to make best use of a large volume of data to optimise trajectories. To that end, higher levels of automation will be introduced in ATM. This requires advanced artificial intelligence (AI)-powered digital support tools, to deal safely with complex decision-making while optimising capacity and environmental performance.

- **Dynamic airspace**: the proposed research shall contribute to enable a near real-time configuration of the airspace with human operators and systems teaming up to meet needs of all airspace users (civil and military) and to manage capacity more efficiently. For certain phases of flight, the system will be fully automated and able to handle both nominal and non-nominal situations.

- **Role and function of human operator**s: the proposed research shall contribute to the gradual evolution of the role and skills of the human operator (e.g., air traffic controllers, air traffic safety electronic personnel, flight crew and operators, etc.), as well as the emergence of new roles.

When relevant and regarding civil military collaboration, the proposed research shall contribute to enhance military access to the airspace and to the ability to protect confidentiality and critical information of military air missions. In addition, it could address the coordination with civilian aviation authorities enabling effective contribution to operations in multinational coalitions and the adaptation of Military systems and CNS capabilities to ensure civil military interoperability. The military implications of U-Space and higher altitude operations (HAO) could also be included.

1.5.2 Work Area 2: Applied research

Specific conditions for WA2	
Expected EU contribution per project	The SESAR 3 JU estimates that a maximum EU contribution of EUR 2.00 million would allow these outcomes to be achieved. Nonetheless, this does not preclude the submission or the selection of a proposal requesting a different amount.
Indicative budget	The total indicative budget for this work area is EUR 14.00 million
Type of actions	Research and innovation action (RIA)
Procedure	The procedure is described in General Annex F to the Horizon Europe work programme for 2023–2025. The following exception applies: to ensure a balanced portfolio, grants will be awarded to applications not only in order of ranking but at least also to those that are the highest ranked within topics within the same work area, provided that the application attains the threshold.

1.5.2.1 *Topic HORIZON-SESAR-2025-DES-ER-03-WA2-1: Research to help shape the future regulatory framework for a DES*

This topic focuses on supporting the evolution of the future regulatory framework to facilitate the implementation of ATM Master Plan as well as the supporting actions identified in the European Plan for Aviation Safety (EPAS). For example: methods to evaluate performance of ATM/ANS ground equipment and determine appropriate assurance levels, the application of airspace classification in Single European Sky (SES) airspace, impact of automation on the air traffic controller regulations (e.g., licencing scheme, rostering, fatigue prevention), artificial intelligence (AI) assurance, human factors, and safety risk mitigation.

Expected outcomes

To significantly advance the following development priority:

- AR-1 Research to help shape the **future regulatory framework for a Digital European Sky.**

The expected outcomes are

- Support the evolution of the future regulatory framework addressing the impact of automation on the human role, providing insight on the challenges and potential solutions to design AI and non-AI based automation tools.
- Contribute to a harmonised application of airspace classifications in Europe.
- Improve ATM safety developing applications of Data4Safety.

Specific requirement for this topic

- Research activities carried out under this topic should always duly consider and assess the potential impact of the proposed regulatory evolutions on military aviation, in particular military operations and training.

Scope (R&I needs)

1. **Evolution of the human operator role and automation**

The target vision presented in the ATM Master Plan and in the EASA artificial intelligence (AI) Roadmap entails a technological evolution that will transform the way air traffic services are provided: human operators will delegate a substantial number of tasks to the automation, and both together will form a human – machine teaming able to handle an increasing traffic demand more safely and efficiently.

The research requires a multidisciplinary approach, involving safety, human performance, legal, insurance, regulatory, etc. expertise and shall be use-case driven. The objective of this research is not the development of an ATM solution with a high level of automation but, building on one or more ATM solutions (use-cases) proposing automation level 3 or 4 (human supervision or human safeguarding) based on conventional deterministic algorithms (i.e., not based on artificial intelligence).[54] assess the evolution of the human operator role and automation.

Research shall develop a thorough state of the art of the HF impact on automation and mitigation methods that are applicable in ATM and propose standardized measurement methods to quantify the adverse impacts.

Research aims at identifying and analysing:

- How the technological evolution (degree of automation and supervisory vs. executive role) impacts the nature and frequency of human operators' interventions/tasks, the required competencies, their states e.g., fatigue and subsequently their overall performance.

- Potential safety hazards related to the transition to an evolved human operator role, which might impact human operator cognitive skills and capabilities, and with the new role (e.g., specific to a supervisory role).

- The potential loss of sense of control by the human operator due to future technological developments, acknowledging the range of working environments and operational circumstances within Europe. The potential loss of sense of control might be related to a potential shift and further reduction of human operator tasks, resulting from future technological developments. Such a shift of human operator tasks might be expected but it is yet unclear into which direction supporting technologies develop on the medium and long-term and whether and how this might cause loss of sense of control.

- Joint cognitive systems and adaptative automation are promising developments, for which additional scientific studies are recommended because the maturity level and evidence for their effect on human operator workload and fatigue is still scarce. As these technological developments continue to evolve in the coming years, continued collaboration between researchers, technology developers, and regulatory bodies is recommended.

ATSPs could find solutions to reduce the risk of drowsiness in two opposing directions: a) by reducing automation such that bore-outs due to low task load are avoided, and b) by increasing automation such that, during certain periods, human operators could relax or could execute other tasks than monitoring to avoid fatigue later in their working session. Both directions have benefits and risks and are not yet fully addressed in research. Further research is therefore recommended to study these opposing approaches and address topics such as:

- Technological feasibility of (adaptive) automation that can intervene in ATC operations.

- (Operational) tasks to maintain human operator vigilance during periods low traffic demand.

- Means of optimal human operator engagement.

[54] Note in this element AI algorithms are excluded in order to focus the research on the challenges posed by automation, rather than on the challenges posed by AI. AI challenges are covered in another element.

Research may consider meta-analyses and/or assessment of mitigation methods, and/or standardizing procedures, etc.

The research shall consider and complement the initial considerations of the "EASA ATCO Fatigue study" on the impact of new technologies on human operator workload and fatigue[55] as well as the EASA's approach on AI, as presented in the AI Roadmap[56]. On-going work performed by project IFAV3 on increased flexibility of human operator validations is also relevant.

The results of the research shall aim at providing factual scientific data that could substantiate intervention strategies (e.g., further rulemaking, implementation support, oversight, etc.) in the field of human operator training, competence, and fatigue management, as well as in relation with the introduction of new ATM/ANS functionalities.

The output of the research will support impact assessment and future decision making by EASA on the regulatory needs associated to the deployment of the solution. The assessment shall include the consideration of legal accountability in case of an incident.

2. Research on human operator fatigue and rostering practices

The following research topics are proposed with the aim to further increase the knowledge and scientific evidence on human operator fatigue prevalence, causes and effects, and effective prevention and mitigation, and thereby support future decision-making by EASA. The research shall consider the "Study on the Analysis, Prevention and Management of Air Traffic Controller Fatigue"[57] published by EASA in May 2024:

- Extend the scientific knowledge about the prevalence, causes and impact of human operator fatigue including a varied and representative sample of EU ATSPs and human operators (e.g., human operators of the oldest age group) in human-in-the-loop experiments (e.g., using simulator(s) or a highly controlled operational environment). These experiments shall:
    - Further research to identify and propose recommended bracket values of the eight roster elements[58] maintaining the risk of human operator critical fatigue at low to moderate level; the bracket values should take into account and be correlated, if possible with traffic volumes and complexity, seasonal activities, and nominal and non-nominal (e.g. crisis) situations, beyond the results documented in the EASA study: collecting data during longer and more varied measurement periods (e.g. both summer and winter), targeting air traffic service providers (ATSPs) with specific schedules, work procedures, and variation in

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[55] https://www.easa.europa.eu/en/domains/air-traffic-management/atmans-workforce-air-traffic-controller-%28ATCO%29-fatigue.

[56] EASA Artificial Intelligence Roadmap 2.0 published - A human-centric approach to AI in aviation | EASA (europa.eu)

[57] https://www.easa.europa.eu/en/domains/air-traffic-management/atmans-workforce-air-traffic-controller-%28ATCO%29-fatigue.

[58] Maximum consecutive working days with duty (days), maximum hours per duty period (hours), maximum time providing air traffic control service without breaks (minutes), ratio of duty periods to breaks when providing air traffic control service, minimum duration of rest periods (hours), maximum consecutive duty periods encroaching the night-time (days), minimum rest period after a duty period encroaching the night-time (hours) and minimum number of rest periods within a roster cycle.

traffic volumes and complexity. If these criteria have an influence on human operator critical fatigue, an associated fatigue risk index should be provided.

    - Further research into the correlation and cross effects of the 8 mandatory parameters (e.g. number of maximum consecutive days vis-à- vis maximum hours per duty) as well as on the time needed to reduce/dissipate critical fatigue risks.
    - Further research on the various national labour laws in the EU and their impact on the rostering practices.
    - As far as possible, based on the above-mentioned research, identification of a methodology to calculate human operator staffing levels in ATSPs.
    - Investigate the impact on work-life balance and human operator fatigue of rostering schemes (e.g., days in advance rostering is published, flexibility for human operators to express shift preferences (e.g., to adapt to the individual circadian rhythms of morning persons / night owls), shift swapping between human operators / centralised shift swapping between individual human operators and the system, etc.). Investigate how the results of this study could be used within rostering and fatigue management systems.
    - Further collect data on the actual content of working hours in the EU ATSPs and confirm the share of operational and non-operational duties. Consider the nature of non-operational duties and measure the effect of these duties on fatigue and performance. Propose a definition of working hours and what it should or not include in view of the impact on fatigue. Finally, assess the effect of the rostering period scheme, the number of working hours per rostering period (and number of working hours per week (or month)) on (cumulative) human operator fatigue and determine the maximum number of working hours per rostering period to recommend.
    - Consider the nature of non-operational duties and measure the effect of these duties on fatigue and performance.
    - Assess the impact of new technologies on fatigue in an objective manner, while controlling for other factors (such as rostering and workload).

- Provide an updated assessment of current developments in fatigue detection technologies.
- Develop objective non-intrusive new fatigue monitoring technologies (e.g., wireless electrode electroencephalogram (EEG), speech analysis and webcam-based eye tracking, etc.) to be used in the ATC operational environment. Research shall take into consideration ethical and data privacy issues, particularly in the context of general data protection regulation (GDPR) guidelines. Future developments in fatigue detection and/or monitoring should therefore address the balance between leveraging the benefits of advanced monitoring technologies and safeguarding individual privacy by integrating robust data protection measures, ensuring compliance with regulations, and addressing ethical considerations to gain acceptance within the ATC community. As these technologies continue to evolve, ongoing collaboration between researchers, technology developers, and regulatory bodies is strongly recommended.

- Provide recommendations for the update of the SESAR human performance assessment methodology used by R&I projects in the SESAR programme to improve the consideration of fatigue at various stages of development and implementation of new technologies, including the assessment of the impact on fatigue of new concepts that make human operator role more passive/monotonous, for the manufacturers, the ATSPs and competent (oversight) authorities; in this regard assess the possible link with the Research project on the methods to evaluate the performance and impact of ATM/ANS ground equipment on human operator fatigue.

Proposals shall define mechanisms for guaranteeing the absence of conflict of interests.

The results of the research shall aim at providing factual scientific data that could substantiate intervention strategies (e.g., further rulemaking, implementation support, oversight, etc.) in the field of human operator fatigue management and working practices. Note that there is on-going work performed by project IFAV3 on increased flexibility of human operator validations.

3. Methods to evaluate safety requirements of ATM/ANS ground equipment and determine appropriate assurance levels

The lack of harmonised and recognised methods for ensuring the safety and interoperability of ATM/ANS system and constituents (ATM/ANS equipment) (e.g., identification of failure conditions, definition of hardware and software requirements, safety assurance of commercial of the shelf (COTS) equipment, etc.) has resulted in a significant number of different approaches applied by the equipment manufactures and air navigation service providers (ANSPs). Although there are industry standards and methods available for determining the appropriate safety assurance, these standards are not fully compatible with each other.

Furthermore, modern ATM/ANS equipment and those envisaged to by the ATM Master Plan are to make significant use of data through the application of virtual systems (e.g. through application of cloud computing).

With the transition to the EASA framework for attestation of ATM/ANS equipment (Commission delegated regulation (EU) 2023/1768 of 14 July 2023), there is a need to ensure a common approach and understanding of the safety requirements, liability aspects, assurance level and that harmonised methods are applied.

Research shall aim at providing data and information to determine:

- Certification characteristics and performance of hardware platform cloud computing and COTS solutions/equipment.
- How best to ensure the suitability for use of COTS equipment or constituents.
- Principles, assurance methods, and safety considerations to be applied in guaranteeing computing platform, virtual systems, and software applications provide their performance and safety targets.
- A methodology applicable to ATM equipment to determine “failure conditions”.
- Shared liability principles for assurance of certified equipment being used in a more highly automated operating environment.

- Principles, methods, and safety considerations to determine software assurance level (SWAL) and hardware assurance level (HWAL).

The research results will support EASA rulemaking activities (e.g., RMT.0744[59]) to further develop and complete the initial set of detailed specifications (DS-GE[60] and DS-SoC[61]) (see ED Decision 2023/015/R[62]). The resulting changes to the detailed specifications will enable the application of the appropriate safety requirements, harmonise assurance methods, and clarify the certification and declaration of ATM/ANS equipment, thus ensuring the safety, interoperability and functioning of the Single European Sky and provide a common approach and understanding of the safety requirements.

Research shall consider the on-going standardisation activities by international committees under EUROCAE WG 117 and WG 127 aiming at developing Means of Compliance to address the above challenges.

4. The application of airspace classification in Single European Sky airspace

Through the application of SERA.6001 Classification of airspaces of the Annex to Regulation 923/2012, a common definition of the airspace classification has been implemented. However, the designation by the Member States has resulted is an unharmonized application which leads to flight inefficiencies, decreased safety and difference in service expectations when conducting operations in similar airspace within different Member States.

Research shall provide the data and information (including U-space implementation), to determine:

- The distribution of the application of airspace classification in Member States airspace and the context of such application. The research must address in particular the implementation of class G airspace across Europe.

- A reasoned framework (including a set of parameters based on traffic demand) to support a harmonised application of the airspace classifications.

The research should consider current traffic demand and future traffic forecast, considering (in particular) VFR and IFR electric aircraft as per the EASA certification projections, as well as very low level (VLL) operations.

A harmonised application of airspace classifications in Europe will support the safe and effective operations by commercial and large aircraft and general aviation. Research shall provide the required evidence and initial inputs to define an intervention strategy (e.g., further rulemaking,

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[59] https://www.easa.europa.eu/en/document-library/terms-of-reference-and-rulemaking-group-compositions/tor-rmt0744

[60] Declaration specifications and AMC and GM for ATM/ANS (ground) equipment.

[61] Detailed specifications for ATM/ANS equipment subject to statement of compliance.

[62] ED Decision 2023/015/R - Conformity assessment of ATM/ANS equipment | DS-GE.CER/DEC — Issue 1 and DS-GE.SoC — Issue 1 | EASA (europa.eu).

implementation support, etc.) to define the classification application conditions in support of a Single European Sky.

5. Development of guidelines for the design of future artificial intelligence (AI) systems

Research shall aim at supporting the evolution / update of EASA guidelines for the development of AI enabled systems in ATM, including feedback on the effects of conformance, transparency and complexity and other challenges associated to the design of future AI systems (e.g., trade-offs between privacy and transparency, trustworthy AI approaches). Research shall take as starting point the issue 02 of the EASA AI concept paper[63].

Research shall identify concrete applications of EASA guidelines and define the appropriate activities, not only human-in-the-loop simulations considering controller trust, acceptance, workload and human/machine performance but also new approaches for validation, verification, and testing of AI applications, specifically for safety critical applications (e.g., developing an agile validation methodology and data centric security capabilities for AI systems to promote their reliability, increase trust on AI, and maintain a competitive edge in today's rapidly evolving technological landscape).

Close coordination with EASA is expected, to ensure complementarity and consistency with EASA activities on the following areas:

- Trustworthiness: capability to keep AI-based systems with relatively high cyber-security protection. Support the definition of the requirements and needs for input/output verification (related to trustworthiness in the framework of Structured Transparency) in the ATM context in support of the EASA certification process descriptions. Validate and further develop requirements and potential solutions with a co-joint analysis together with EASA and other operational experts. Clarify some of the challenges faced by EASA (e.g., to define the system requirements, processes, and tools that are needed to perform the validation and certification process).

- Learning Assurance: including the consideration of realistic operational cases in realistic operational conditions and new machine learning (ML) techniques. Need to develop specific assurance methodologies to deal with learning processes.

- AI explainability, which goes beyond the ML techniques to extract information from the models and includes the interactions with other systems and with the human operators (human factors). Research may help to clarify which requirements and processes the target AI/ML system should comply with to be certifiable for operations.

- AI Safety case: discussing with EASA and other safety experts about the needs and requirements of a concrete safety-case can help to clarify and support the development the EASA guidelines for certification.

The concept of safety critical levels needs to be further developed for AI applications in ATM. Research covers the definition and analysis of safety-related use cases for different safety level assurances. These safety levels may imply either the adaptation of current software (SW)

[63] https://www.easa.europa.eu/en/document-library/general-publications/easa-artificial-intelligence-concept-paper-issue-2

verification methods or the development of new ones to guarantee the safe of operation of AI in ATM.

Research shall consider the on-going standardisation activities by EUROCAE WG114 – SAE G34, which is a joint standardization initiative to support Artificial Intelligence revolution in aeronautics.

6. Enhancing robustness and reliability of machine learning (ML) applications

Research aims at enhancing machine learning (ML) applications to ensure they are technically robust, accurate and reproducible, and able to deal with and inform about possible failures inaccuracies and errors. Research aims at developing potential solutions to address this challenge, which shall include/refer to the EASA methodologies for certification of AI in aviation. The research must be focused on the application of ML to ATM, by either leveraging existing ML techniques or by developing new ML techniques to address the specific challenges. Research shall consider the results and recommendations reported in the machine learning application approval (MLEAP) final report[64].

The scope may address:

- Further the research on "generalisation capabilities of ML models and constituents", as the MLEAP final report indicates the need for further work (the set of methods experimented on use cases do not provide satisfactory generalisation bounds and other methods should be further investigated).
- Verification methods of robustness for machine learning (ML) applications. Due to the statistical nature of machine learning applications, they are subject to variability on their output for small variations on their input (that may even be imperceptible by a human). Research aims at proposing new methods to verify the robustness of machine learning applications, as well as to evaluate the completeness of the verification.
- Standardised methods for evaluation of the operational performance of the machine learning (ML). Research addresses the definition of reference methods and metrics to assess the accuracy or error rate of ML applications.
- Application of transfer learning and data augmentation techniques for the development of the proposed applications, thus guaranteeing their robustness. In addition, these systems would be continuously validated using ML Ops methodology and explainability techniques, to ensure system performance and detect as early as possible if concept drift is occurring.
- Identification, detection, and mitigation means of bias in ML applications. Machine learning applications are subject to bias, which can compromise the integrity of their outputs. One of the most challenging aspects when collecting, preparing, or using data, is the capability to identify, detect and finally mitigate adequately any bias that could have been introduced at any time during the data management and/or of the training processes. Research aims at developing potential solutions to address this challenge.

[64] https://www.easa.europa.eu/sites/default/files/dfu/mleap-d4-public-report-executive_summary_expanded-issue01.pdf

- ML/AI-based systems must be designed, deployed and executed while considering cyber-security aspects to prevent, detect, mitigate and respond to attacks and ensure that the system is cyber-resilient. Peculiarity in threat models, risk assessment, and monitoring of ML/AI systems must be considered.

7. Support to the certification of novel ATM (AI-based and non-AI-based) systems that enable higher levels of automation

The objective of this research element is to address issues related to the certification of:

- Novel AI-based ATM systems that enable higher levels of automation (level 3 and above, which corresponds to EASA AI levels 2B and above).

- Novel non-AI based ATM systems that enable higher levels of automation (level 3 and above).

Research will address solutions, methods, etc. that could support and harmonise certification of innovative ATM systems based or not on machine learning or artificial intelligence techniques (e.g., scenario-based testing, reinforcement learning for control systems, etc.). It is expected that proposals define a holistic approach to address this challenge considering not only technical aspects of the certification but also legal and regulatory aspects including privacy. Research may explore and assess potential approaches that could be applied for the certification of automation and that allow to demonstrate the safety of automation during nominal and non-nominal conditions. Of particular interest is to show how safety can be ensured even if not all situations and variations of parameters can be anticipated during the design phase. Proposals may apply uncertainty quantification to address this issue. Research may also address the specific challenges of certification of automation that can adapt its behaviour to changes of the environment over time. Research activities shall consider other initiatives developing safety of life systems that may have different approaches to certification and review their applicability to ATM (e.g., EGNOS). Research shall consider the work performed by project HUCAN.

See automation levels as in the ATM Master Plan in the section on general principles.

8. Development of a framework to achieve effective Human-AI Teaming

Based on the published EASA Artificial Intelligence (AI) Roadmap 2.0[65], the issue 02 of the EASA AI concept paper[66] was published. This guidance document develops a novel layer of AI trustworthiness guidance related to Human Factors for AI, which is necessary to manage the approval of Level 2 AI applications, which encompasses (Human-AI Teaming).

Such applications bring the level of assistance from the AI-based systems to the Human end-user one level beyond, enabling automatic decision-making or action implementation, which was not foreseen in the Level 1 AI applications (Human assistance and augmentation).

When considering an AI-based system as a part of a team, rather than simply a tool capable of limited actions, the need for a framework for improving the design of AI-based systems to enhance the overall success of Human-AI teams becomes obvious. A failure to consider the needs

[65] https://www.easa.europa.eu/en/document-library/general-publications/easa-artificial-intelligence-roadmap-20

[66] https://www.easa.europa.eu/en/document-library/general-publications/easa-artificial-intelligence-concept-paper-issue-2

of the many air traffic controllers, pilots, flight dispatchers, flow managers, etc. who are responsible for successful operations will result in AI technologies that eventually fail to provide the necessary high levels of performance and may instead cause inefficiencies and safety concerns.

The design of AI-based systems for Human-AI teams needs to incorporate several highly interrelated considerations. These include designing the AI system to support not only task work, but also teamwork. These interrelated considerations include considerations about Human-AI team performance and processes, AI-based system situation representation, shared situational awareness, human team member training needs, Human-AI interaction methods, interface, AI operational explainability and Human-System Integration processes, measures, and testing.

Research aims at investigating concrete and feasible means of compliance for the new layer of Human Factors objectives and how compliance could be assessed including a definition of KPIs for performance in new roles for human, non-human, and hybrid teams. The research project could also lead to complement anticipated means of compliance for the Human-AI Teaming.

Research may include the creation of frameworks / methods for training AI-based systems together with humans, to be able to include in the objective functions notions of collaboration or KPI related to team success, and not only individual goals. The absence of standardised testbeds in AI-based ATM research fragments it and prevents truly collaboration between the research actions, even more so in the domain of Human-AI Teaming.

The research shall take as a starting point one or more use cases of application of automation level 2 to ATM that do not use AI and are already at a maturity level TRL6 or above and investigate the potential introduction of AI to enhance the performance of the Human-AI team.

Research should demonstrate a clear relationship between the human factors objectives and implementation in the wider socio-technical system (e.g., training, procedures, competence certification, etc.).

Along with the research, at least one real-scale aviation use case per domain (covering at least ATM/ANS and airworthiness) should be developed to demonstrate the effectivity and usability of the proposed methods and tools.

The expected short-term benefit is to support certification and approval processes by identifying concrete means of compliance to the Human-AI Teaming objectives of EASA guidance for AI applications (AI Level 2 and 3A as defined in EASA AI Roadmap), with a specific focus on AI Level 2A and AI Level 2B. Transitions between levels should also be considered.

The expected medium-term benefit is to enable advanced type of automation in different domains covered by the EASA Basic Regulation (Regulation (EU) 2018/1139[67]), with enhanced Human-AI teaming capabilities of AI-based systems.

9. Explainable Artificial Intelligences (XAI)

[67] https://www.easa.europa.eu/en/document-library/regulations/regulation-eu-20181139

AI explainability is the capability to provide the human with understandable, reliable, and relevant information with the appropriate level of detail and with appropriate timing on how an AI/ML application produces its results.

Applicable EASA guidance[68], which shall be considered by the research on this topic distinguishes between development & post-ops explainability (driven by the needs of stakeholders involved in the development cycle and the post-operational phase) and operational explainability, which refers to the need to provide end users with 'understandable' information on how the AI/ML-based system came to its results.

The research shall address the following aspects:

- Elaborate a state of the art review to evaluate the progress made on XAI by several research groups (e.g., DEEL (dependable, explainable and embedded learning)).
- Based on the state of the art review identify and develop further axes of research.
- Investigate the "relevance property" highlighted in machine learning application approval (MLEAP) final report[69]. The impact of inputs on outputs is an important consideration to promote when trying to explain complex models such as neural networks (NN). Similarly for control related applications (e.g., reinforcement learning), the "reachability property" from the same MLEAP report may also be of interest.
- Despite the inherent case by case nature of compliance methods to explainability objectives, it is important to research a common baseline of methods/tools for specific groups of AI/ML applications (e.g., type of technology, type of application, dimensionality, etc.).

The objective of this research is to improve transparency of automated systems in the ATM domain investigating methods based on Explainable Artificial Intelligence (XAI) in operational use cases e.g., predicting air traffic conflict resolution and delay propagation, validating the robustness and transparency of the system, etc. Research shall consider the output of project ARTIMATION and MAHALO.

10. Innovative methodologies for ATM safety, security, and resilience

Research aims at developing methodologies (or evolution of existing ones) for safety, security and resilience that will contribute to ensure that ATM is robust against ever-evolving risks, threats, and disruptive events in the physical and cyber worlds in a novel ecosystem (e.g., enabled by automation level 3 and above). Moreover, research shall consider how novel virtualized and distributed ATM service architecture can be cyber-resilient and collaborate to enhance the overall security approach. New and disruptive technologies, operations, and business models to ensure ATM is resilient against internal and external threats, including health, natural disasters, terrorism, and criminal activity. Research shall ensure coordination with EASA. Research shall consider the work performed under projects SEC-AIRSPACE, FARO and FCDI.

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68 https://www.easa.europa.eu/en/document-library/general-publications/easa-artificial-intelligence-concept-paper-issue-2

69 https://www.easa.europa.eu/sites/default/files/dfu/mleap-d4-public-report-executive_summary_expanded-issue01.pdf

11. Applications of Data4Safety

Data4Safety (also known as D4S) is a data collection and analysis programme of the European Union Aviation Sector that will support the goal to ensure the highest common level of safety and environmental protection for the European aviation system.

The programme aims to provide a big data platform and analysis capability at European scale and level, including a structural link with ECCAIRS2 that enables analytics and insights from the European Central Repository safety data (ECR as per Regulation (EU) 376/2014[70]). This means collecting and gathering all data that may support the management of safety risks at European level including safety reports (or occurrences), flight data (i.e., data generated by the aircraft via the flight data recorders), surveillance data (air traffic data), weather data, etc. As for the analysis, the programme's goal is to help to "know where to look" and to "see it coming" as well as to support data-driven changes at system level. In other words, it will support the performance-based environment and set up a more predictive system. More specifically, the programme will allow to better know where the risks are (safety issue identification), determine the nature of these risks (risk assessment) and verify if the safety actions are delivering the needed level of safety (performance measurement).

Research aims at defining, developing, validating, and assessing potential future applications / use cases of the data collected under Data4Safety Programme, which could be later integrated during the next stages of the D4S development phase. The goal is to improve the overall capacities of the European Union aviation system to manage risks and support data-driven changes with adapted aviation intelligence, by developing the capability to discover vulnerabilities in the system across terabytes of data.

The focus should be on the utilization of training data for ATM human operators and pilots in correlation with aviation data derived from in-service operations, rotorcraft, general aviation, and drones' operations and in the field of environment.

12. Automation of the security risk assessment (SecRA) process

Security risk assessment is a resource-intensive, time-consuming process which incorporates the identification of assets, vulnerabilities, threats and threat scenarios, the evaluation of risk, and the selection of security controls to meet organisational security objectives. There is currently a global shortage of cybersecurity practitioners who can do this work, and this will remain the case for the next few years.

New European regulations (Part-IS) mandate information security management system (ISMS) requirements on aviation organisations and authorities, many of which have previously not been subject to such requirements and may not have implemented an ISMS or carried out security risk assessments in the past. The main objective of Part-IS is to address information security risks which may have an impact on safety, so mechanisms must also be in place to support the coordination of the aviation safety and security disciplines.

Automating the security risk assessment (SecRA) process would assist organisations and authorities to meet the needs of Part-IS by easing the development of SecRAs while reducing the resources required.

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[70] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32014R0376

Possible phases in achieving this:

- The automated update and maintenance of the required catalogues in an existing SecRA (e.g., assets, threats, vulnerabilities, and controls) from established sources of such data.
- The automated generation of reports on the impact of catalogue updates on an existing SecRA (e.g., describing which parts of the SecRA are potentially impacted by a new threat, a new vulnerability, a modified control, etc.).
- The development of a new SecRA, or the modification of an existing SecRA, by an information security specialist supported by an intelligent assistant.
- The autonomous development of a new SecRA, or the modification of an existing SecRA, by an AI agent.

Part-IS refers to ISO/IEC 27001:2022 as a suitable standard, so ISO/IEC 27005, and a compliant tool, may be a suitable approach to apply for SecRA development.

In addition, the utilization of Intelligent Assistants (IAs) could facilitate Human/AI teaming in security and safety risk Assessment activities, such as in the following areas:

- Providing support to safety and security experts in assessing the potential impacts of security incidents on safety, and in the optimal selection of security controls.
- Assessing the potential impact of security controls on safety - and vice-versa.

13. Climate and environmentally driven route charging

Research shall address the potential of climate and environmentally driven route charging, with new mechanisms for charging airspace users to incentivise minimum climate impact. Route charging will reward those who avoid volumes of airspace with a high climate impact and disincentivise flight planning through high demand sectors / flight altitudes except where it optimises environmental benefit overall, while being cost neutral to airspace users and passengers on average. Added capacity in the "greener" volumes of airspace enabled by reduced vertical separations limits necessary flight plan modifications, furthering acceptance of the approach. Note that there is on-going work on this research element under projects Green-GEAR and AEROPLANE.

1.5.2.2 Topic HORIZON-SESAR-2025-DES-ER-03-WA2-2: Integration of the next generation aircraft for zero/low emission aviation

Aims at exploring the ATM aspects of the integration of the next generation aircraft for zero/low emission aviation as foreseen in the European Alliance Zero-Emission Aviation (AZEA) CONOPS.[71] and Clean Aviation JU programme (https://www.clean-aviation.eu).

Expected outcomes

To significantly advance the following development priority:

[71] https://defence-industry-space.ec.europa.eu/document/download/0672fd2c-c99d-4f5b-bc3e-6c6d9dc67019_en?filename=AZEA%20CONOPS%20v1.0-final.pdf

- AR-3 **Integration of the next generation aircraft for zero/low emission aviation**.

Scope (R&I needs)

1. Integration of the next generation aircraft for zero/low emission aviation

The future vision of air transport without net carbon emissions supporting the Green Deal goal includes the introduction of hydrogen (combustion and/or hydrogen fuel-cells), battery-electric and hybrid-electric powered aircraft. These aircraft are currently in the development phase, and their entry into service is not expected until the next decade. Once operations start, their numbers are expected to increase rapidly, which is why the ATM Master Plan sets an objective to ensure that the ATM system is ready to fully integrate them from the start. The goal is that these operations can take place safely, efficiently and without a disproportional impact on conventional (i.e., current generation of kerosene-powered aircraft) air traffic operations.

It is anticipated that these new aircraft will present challenges to ATM in the following areas:

- Evolution of the fleet-mix with increase diversity in aircraft performance: the new aircraft present different performance envelopes than current aircraft for example in terms of cruising levels, cruising speed, final approach speed and rates of climb and descent. This is a challenge for ATM because operations are currently organised considering the current fleet mix.
- Different requirements for airport operations (e.g., turnaround times, ground handling, etc.), which will affect the airport operations plan (AOP)/network operations plan (NOP) integration concepts (e.g., new / adapted airport infrastructure longer turn-around times, new refuelling processes, etc.).
- The new aircraft will have lower range and will also carry a lower number of passengers per flight, which may lead to an evolution of the traffic demand (e.g., new city pairs, more flights to carry the same number of passengers, etc.).

This analysis must take into consideration the different aircraft type / models and propulsive systems under development. The objective of the research is to collect requirements for the seamless integration of the new models / propulsive systems in European airspace, and where appropriate provide recommendations for ATM developments (potentially proposing roadmap if appropriate), addressing, for example:

- Trajectory based operations (TBO) already provides a framework to allow the optimisation of individual flights powered by conventional fuel or sustainable aviation fuel (SAF). There is a need to assess how this framework can support the optimisation of low or zero-emissions aircraft, and where necessary propose enhancements.
- Applicability of new ATM concepts supporting sustainability (e.g., green taxi, wake energy-retrieval, etc.).
- Adaptation of ATM platforms to support the evolution of the fleet to include increased diversity of performance envelopes.
- Potential impact on airports (including regional airports) and AOP/NOP integration due to the impact on the predictability of airport operations (e.g., due to longer turnaround,

changes to airline scheduling patterns, new flight planning/flight plan acceptance processes, new fuelling procedures, new engine start-up requirements, etc.).

- Evolution of aircraft design characteristics, for significantly increased fuel efficiency and minimising emissions, for example with new generation single-aisle model for long-haul, triggering the need for additional wake turbulence research in order to define criteria and guidelines establishing boundaries between wake categories (e.g., around medium aircraft) regarding refined decay characterisation and initial vortex spacing factor, for facilitating design and certification in relation to optimised assignment to advanced wake separation schemes (RECAT-EU or Pairwise, complementing reference analysis), and limiting potential impact on airports capacity and on operational efficiency, related to arrival and departure runway throughput.

- Different propulsion characteristics and failure cases could impact take-off and/or landing distances, heavier H2 aircraft (at landing) could drive higher approach speeds or increased wake vortex class compared to equivalent Kerosene powered aircraft, etc. There is a need to assess the potential impact on route design (e.g., standard instrument departure routes (SID) and standard instrument arrival routes (STAR) design, approach procedures, RNP specifications, etc.).

- Potential impact on traffic synchronization (e.g., sequencing and separation of traffic with different descent / approach performance, take-off / climb characteristics, etc.).

- Potential impacts in terms of traffic demand (e.g., less capacity per aircraft in terms of passengers) as well as complexity and finally capacity to manage aircraft with different performances.

- Impact on airspace management, network management and traffic flow management processes due to the different optimum cruise altitude/speeds for the new aircraft and propulsion concepts (e.g., impacts on airspace configuration, air traffic flow and capacity management (ATFCM) processes, etc.).

- Prediction of the evolution of traffic demand, due to e.g., shorter routes, more flights to accommodate the number of passengers. The impact of different policy scenarios could be considered (e.g., short-haul ban, multimodal regulations, etc.).

Research also includes the definition of a potential future scenario(s) representative of future demand for 2035 including:

- Different combinations of future fleet composition, models / propulsive systems with different capabilities (payload / range / speed), with expected entry into service (EIS) by 2035 and different ramp-up / infrastructure scenarios, covering the Hybrid-Electric Regional, short medium range aircraft (SMR), a Hydrogen-powered options considered in Clean Aviation.

- Different future ATM concepts expected to be implemented by 2035, considering the impact of the variety of vehicle performances and their impact on traffic management.

Oher future scenarios could address a longer-term vision (e.g., 2040+ (SMR H2), 2045+ (Long-range aircraft (LR)) combined with more innovative Phase D ATM operational concepts.

Research shall evaluate the impact on performance such as the reduction of the CO_2 emissions, the environmental impact of H_2 and water (contrails) from hydrogen-powered fuel cell systems on at fleet scale, etc considering the scenarios defined above. Research may also address the impact on other relevant key performance areas (KPA) such as capacity, access and equity, etc.

Research shall identify the needs for the adaptation of the regulatory framework for air navigation and aerodromes (including new requirements, means of compliance) and the related safety standards.

The research shall consider the work performed under the AZEA initiative (i.e., CONOPS) and the Clean Aviation Joint Undertaking programme, and coordinate as necessary with EASA to ensure that safety concerns have been sufficiently addressed.

2 Call HORIZON-SESAR-2025-DES-IR-02

2.1 Scope of the call

This call is focused on significantly advancing the six development priorities defined in the ATM Master Plan for Industrial Research in relation to Phase D and reflect the need to focus on developing the next generation platforms.

These six development priorities for industrial research are:

- Transformation to trajectory-based operations.
- Transition towards high performance of air-ground connectivity (multilink).
- Future en-route and TMA ground platforms.
- Future airport platform.
- Autonomy and digital assistants for the flight deck.
- U3 U-space advanced services, innovative air mobility (IAM) and vertiports.

The development priorities are decomposed into development actions (see Appendix B).

The IR2 call specifications are structured in seven **work areas (WA)**: one work area per development priority (from **WA1 to WA6**) (traced to the development actions as in Appendix B) and an additional one **WA7** to cover the transversal activities in support of SESAR 3 JU and the R&I programme. The content of each work area is decomposed into one or more topics, which cover research needs.

2.2 General principles for the call

Proposals addressing the topics under this call shall consider the following general principles:

- Proposals shall identify and justify the link between the proposed solution(s) and the ATM Master Plan development priorities and related actions defined in the ATM Master Plan (MP).

- Proposals are not requested to address all detailed R&I needs identified under a topic; proposals can pick-up a number of these R&I needs described in the scope of each topic.

- For WA1 to WA5, the targeted maturity level for industrial research is TRL6. Proposals may target TRL4 if duly justified unless otherwise specified in the topic description. Proposals shall not target TRL lower than TRL4 for any of the proposed SESAR solutions. Intermediate TRLs (i.e., TRL3, TRL5) are not applicable.

- For WA6 (fast-tracks), the target maturity level is TRL7, at least for one of the proposed SESAR solution(s). Proposals can also address other SESAR solutions targeting a lower TRL, if duly justified.

- Proposals shall identify the specific and concrete pre-requisites (e.g., SESAR solution(s) / element(s) part of the strategic deployment objectives (SDOs)), if any, which constitute the required background on top of which the new solutions will be developed.

- Proposals shall demonstrate their transformative potential for ATM (i.e., potential contribution to one (or more) of the 5 transformation levers proposed by ATM MP (trajectory optimisation, data volumes, automation, dynamic airspace, role and function of human operators)).

- Proposals shall describe (with adequate rationale for each performance impact introduced in figure A4 how the proposed SESAR solution(s) will contribute to the expected performance benefits for Phase D as documented in the ATM Master Plan.

Performance impact (KPA)	Unit	Reference year (2023)(*)	CP1 (up to 2030)	CP1 + Phase C	Phase D	Expected impact by 2050
Airspace capacity (en-route and TMA)	%	8.5 million flights(*)	+ 34 %	+ 60 %	+ 40 % + 80 %	+ 100 % + 140 %
Airspace capacity	%	17.9 million movements(**)	–	+ 15 %	+ 1 % + 5 %	+ 16% + 20 %
Environment (fuel reduction)	kg / flight	6 400	– 22	– 109	– 491	– 600
	%		– 0.3 %	– 1.6 %	– 7.7 %	– 9.3 %
Passenger time saving (departure punctuality)	minute / flight	18	–	– 0.9	– 6.1 – 8.1	– 7 – 9
Cost-efficiency (air navigation services cost reduction)	EUR / flight	1 077	– 26	– 164	– 54	– 209

*10.1 million actual flights generating an average delay of 1.82 min/flight (SOURCE: Performance Review Report (PRR) 2023). 8.5 million flights refers to the number of flights that the network could handle, offering a quality of service of 0.5 minutes of en-route ATFM delay per flight. This estimation is based on the PRR 2001 formula to convert traffic into capacity.
**IFR movements (arrivals and departures) at ECAC airports in 2023 (SOURCE PRR 2023).

Figure A4: Expected performance impact (Phase D) compared to 2023 (ATM Master Plan)

- Proposals shall describe (with adequate rationale) how the proposed SESAR solution(s) will contribute to achieve automation level 4 as defined in the ATM Master Plan within a pre-defined scope and be able to revert to automation level 3 or lower outside of this scope (when a task becomes too complex for automation to handle), or how the proposed SESAR solution(s) will effectively operate in such an environment.

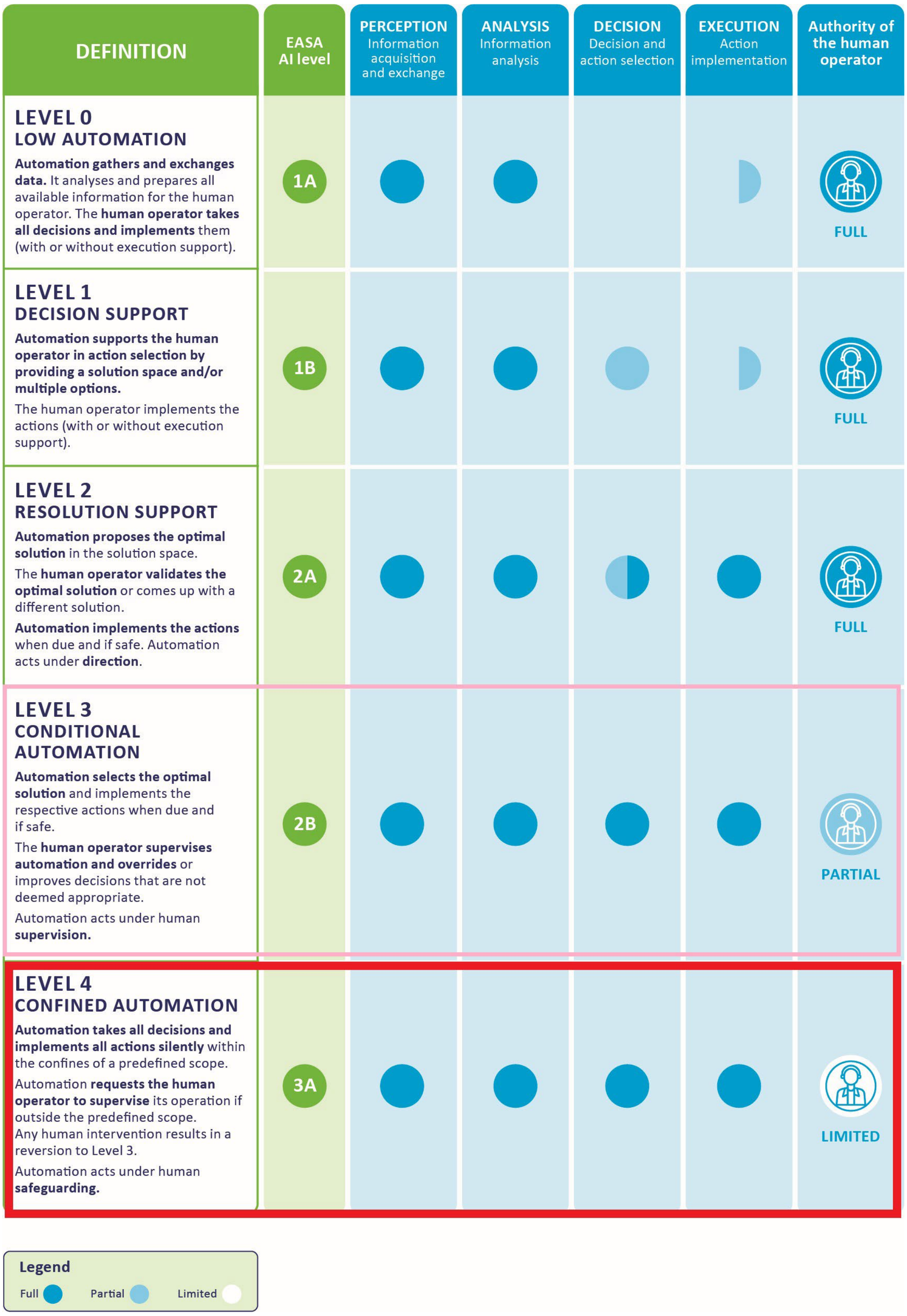

Figure A5: Automation levels (ATM Master Plan)

- Proposals shall describe (with adequate rationale) how the proposed SESAR Solution(s) will be developed aligned to the new service delivery model outlined in the ATM Master Plan. The new services to be developed by the proposals shall meet SWIM registry (https://eur-registry.swim.aero/home) requirements so their interfaces can be later used during the deployment phase.

- The proposed SESAR solutions which would be applying artificial intelligence shall consider EASA guidance and recommendations e.g., issue 02[72] of the EASA AI concept paper[73], which is based on the published EASA Artificial Intelligence (AI) Roadmap 2.0. Research shall assess if the introduction of AI tools may give rise to new cybersecurity threats.

- Proposals may need to consider the execution of integrated validation activities in coordination with one or more projects in other Working Areas and topics. Proposals shall describe these activities in separate work package(s) and identify associated risks in case the other project(s) are not finally awarded.

- The type of deliverables and content that are required as evidence for successfully achieving the target maturity level depends on the type of SESAR solution (ATM solution / Technological solution) and the target maturity level, as per the SESAR programme handbook.

- Proposals shall align to the requirements included in the SESAR project handbook (e.g., performance management, architecture modelling, etc.).

- IR1 and ER2 projects are already in execution: proposals shall justify the complementarity with on-going IR1 and ER2 projects, if the proposals address the same R&I need.

These general principles may be reinforced by specific minimum requirements for some of the topics under this call (see descriptions for each topic).

2.3 EUROCONTROL services

As stated in the Single Basic Act in recital 93, the EUROCONTROL organisation possesses a unique and appropriate infrastructure, together with the necessary administrative, IT, communications and logistics support services that could be beneficial to the implementation of the SESAR 3 Programme.

Applicants could benefit from the following EUROCONTROL expertise and services:

- ATM operational expertise
- civil–military integration expertise
- network operational data
- network management validation infrastructure
- reference tools for the assessment of network performance and environmental impact.

Should the provision of those EUROCONTROL services be required, applicants are invited to coordinate with EUROCONTROL to include the services in their proposals.

2.4 General conditions for the call

Unless otherwise stated, the call follows the general conditions laid down in the General Annexes to the Horizon Europe Work Programme for 2023-2025, adopted by the European Commission[74].

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[72] https://www.easa.europa.eu/en/document-library/general-publications/easa-artificial-intelligence-roadmap-20

[73] https://www.easa.europa.eu/en/document-library/general-publications/easa-artificial-intelligence-concept-paper-issue-2

[74] European Commission Decision C(2024) 2371 of 17 April 2024.

Topic	Type of actions	Budget (million EUR) for 2025	Maximum expected EU contribution per project (million EUR)[75]
Opening: 1 April 2025 Deadline([76]): 16 September 2025			
HORIZON-SESAR-2025-DES-IR-02-WA1-1	Research and innovation action (RIA)	20	10
HORIZON-SESAR-2025-DES-IR-02-WA2-1		14	7
HORIZON-SESAR-2025-DES-IR-02-WA3-1		93	31
HORIZON-SESAR-2025-DES-IR-02-WA3-2		20	10
HORIZON-SESAR-2025-DES-IR-02-WA4-1		24	12
HORIZON-SESAR-2025-DES-IR-02-WA4-2		6	3
HORIZON-SESAR-2025-DES-IR-02-WA5-1		30	6
HORIZON-SESAR-2025-DES-IR-02-WA5-2			6
HORIZON-SESAR-2025-DES-IR-02-WA5-3			6
HORIZON-SESAR-2025-DES-IR-02-WA6-1	Innovation action (IA)	20	5
HORIZON-SESAR-2025-DES-IR-02-WA6-2			5
HORIZON-SESAR-2025-DES-IR-02-WA6-3			5
HORIZON-SESAR-2025-DES-IR-02-WA7-1	Coordination and support action (CSA)	2	2
HORIZON-SESAR-2025-DES-IR-02-WA7-2		1	1
Overall indicative budget		230	

Type of conditions	Information on the conditions
Admissibility conditions	The conditions are described in General Annex A to the Horizon Europe work programme for 2023–2025.
Eligibility conditions	The conditions are described in General Annex B to the Horizon Europe work programme for 2023–2025.

[75] Nonetheless, this does not preclude the submission or the selection of a proposal requesting a different amount.

[76] The Executive Director responsible may delay the deadline(s) by up to 2 months. All deadlines are at 17.00.00 Brussels local time.

	This call is subject to restrictions for the protection of European communication networks.
Financial and operational capacity and exclusion	The criteria are described in General Annex C to the Horizon Europe work programme for 2023–2025.
Award criteria	The criteria are described in subsection 2.4 below. Moreover the following weighting will apply: • excellence: 40% • impact: 40% • implementation: 20%
Documents	The documents are described in General Annex E to the Horizon Europe work programme for 2023–2025.
Procedure	The procedure is described in General Annex F to the Horizon Europe work programme for 2023–2025. All applicants who have submitted proposals under the following topics: ▪ WA3-1 Next generation ATS platforms for en-route and TMA operations and ▪ WA4-1 Next generation ATS platform for airport operations, will be invited to participate in a hearing. The purpose of these hearings will be to: 1. clarify specific elements of the proposals and provide the necessary clarifications to allow the evaluation committee to establish its final assessment and scores, or 2. enhance the evaluation committee's understanding of the proposals to ensure a thorough and accurate evaluation. The evaluation committee will integrate the information gathered during the hearing into the overall assessment, which may affect the final score in areas where clarification was necessary. These hearings will take place in Brussels during the Central Evaluation phase. Participation in these hearings is facultative and applicants who choose not to participate will not be penalised. Whether or not applicants participate in the hearings, the written proposal remains the primary basis for evaluation. Hearings cannot be used to modify proposals. Applicants may only provide explanations and clarifications in response to questions asked by the evaluation committee. Each hearing invitation letter will explain the hearing process, including how it will be conducted and detail on how the outcome of the hearing may impact the final scoring of the proposals. *[In addition to "in-person" hearings in Brussels, applicants will have the possibility to participate remotely to ensure accessibility and equal opportunity for all.]* Hearing invitations letters will be sent to all applicants after the call deadline. The set of specific questions to be addressed will be shared with each applicant before the hearing.

	The following exceptions apply: • the evaluation committee may be composed partially of representatives of EU institutions and agencies (internal experts).
Legal and financial set-up of the grant agreements	The rules are described in General Annex G to the Horizon Europe work programme for 2023–2025. The following exceptions apply. 1) A funding rate of 70% applies to all beneficiaries (regardless of their legal status). 2) Eligible costs will take the form of a lump sum as defined in the Decision of 7 July 2021 authorising the use of lump sum contributions under the Horizon Europe Programme – the Framework Programme for Research and Innovation (2021-2027) – and in actions under the Research and Training Programme of the European Atomic Energy Community (2021-2025).[77]. 3) Beneficiaries will be subject to the following additional dissemination obligations: ○ beneficiaries must make proactive efforts to share, on a royalty-free basis, in a timely manner and as appropriate, all relevant results with the other grants awarded under the same call; ○ beneficiaries must acknowledge these obligations and incorporate them into the proposal, outlining the efforts they will make to meet them, and into Annex I to the grant agreement. 4) Beneficiaries will be subject to the following additional exploitation obligations: For the purpose of complying with the objectives set in Council Regulation (EU) 2021/2085, the SRIA and the European ATM Master Plan, ○ beneficiaries must make available for reuse under fair, reasonable and non-discriminatory conditions all relevant results generated, through a well-defined mechanism using a trusted repository; ○ if the purpose of the specific identified measures to exploit the results of the action is related to standardisation, beneficiaries must grant a non-exclusive licence to the results royalty-free; ○ if working on linked actions, beneficiaries must ensure mutual access to the background to and to the results of ongoing and closed linked actions, should this be necessary to implement tasks under the linked actions or to exploit results generated by the linked actions as defined in the conditions laid down in this biannual work programme and in the call for proposals. - beneficiaries must acknowledge these obligations and incorporate them into the proposal, outlining the efforts they will make to meet them, and into Annex I to the grant agreement. 5) Grants awarded under this topic will be linked to the following actions: Call HORIZON-SESAR-2022-DES-IR-01

[77] This decision is available on the Funding and Tenders Portal, in the reference documents section for Horizon Europe, under 'Simplified costs decisions' or through this link: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/horizon/guidance/ls-decision_he_en.pdf

	Call HORIZON-SESAR-2022-DES-ER-01 A collaboration agreement is required.
Other conditions	The integration of a gender dimension (sex and gender analysis) into R&I content is not a mandatory requirement.

2.5 Award criteria

Industrial research and validation activities (WAs 1, 2, 3, 4 and 5) and fast-track innovation and uptake (WA6)

Type of actions	**Excellence** *(The following aspects will be taken into account, to the extent that the proposed work corresponds to the description in the work programme)*	**Impact**	**Implementation**
Research and innovation actions (RIA) Innovation actions (IA)	1. Clarity and pertinence of the project's objectives: degree to which the objectives and scope are compliant with the call material, well understood and fully addressed 2. Soundness of the proposed methodology for developing the SESAR solutions from their initial to their target maturity level, including the underlying concepts, models, assumptions and interdisciplinary approaches. This criterion also includes appropriate consideration of the integration of a gender dimension into R&I content and the quality of open science practices([78]), including sharing and management of research outputs and engagement of citizens, civil society and end users where appropriate. 3. Level of awareness of the state of the art: degree to which the proposal	1. Credibility of the pathways to achieve the expected outcomes and impacts specified in the call material. 2. Appropriateness of the contribution to standardisation and regulation: the extent to which the proposal demonstrates that the project will contribute appropriately to the relevant standardisation and regulatory activities. 3. Suitability and quality of the measures in terms of maximising expected outcomes and impacts, as set out in the D&E plan, including communication activities.	1. Quality and effectiveness of the work plan and assessment of risks, and appropriateness of the effort assigned to work packages, and the resources overall 2. Capacity and role of each participant and the extent to which the consortium as a whole brings together the necessary expertise.

[78] See the EU's open science policy (https://ec.europa.eu/info/research-and-innovation/strategy/strategy-2020-2024/our-digital-future/open-science_en).

	demonstrates knowledge of current operations and relevant previous R&D work (both within and outside SESAR), explains how the proposed work will go beyond the state of the art and demonstrates breakthrough innovation potential.		

Transversal activities (WA7)

Type of actions	**Excellence** *(The following aspects will be taken into account, to the extent that the proposed work corresponds to the description in the work programme)*	**Impact**	**Implementation**
Coordination and support actions (CSA)	1. Clarity and pertinence of the project's objectives: degree to which the objectives and scope are compliant with the call material, well understood and fully addressed. 2. Quality of the proposed coordination and/or support measures, including soundness of the methodology: degree to which the proposed methodology is feasible and appropriate to address the required coordination and support actions.	1. Credibility of the pathways to achieve the expected outcomes and impacts specified in the call material and of the ATM research. 2. Suitability and quality of the measures in terms of maximising expected outcomes and impacts, as set out in the D&E plan, including communication activities.	1 Quality and effectiveness of the work plan and assessment of risks, and appropriateness of the effort assigned to work packages, and the resources overall. 2. Capacity and role of each participant and the extent to which the consortium as a whole brings together the necessary expertise.

2.6 Specific conditions and description of topics for each work area

2.6.1 Work Area1: Transformation to trajectory-based operations

This working area focuses on completing the industrial research needs that are identified in the ATM Master Plan trajectory-based operations (TBO) roadmap (note that when relevant, research needs from the TBO roadmap have been integrated into WA3 and WA4).

Specific conditions for WA1	
Expected EU contribution per project	The SESAR 3 JU estimates that a maximum EU contribution of EUR 10.00 million would allow these outcomes to be achieved. Nonetheless, this does not preclude the submission or the selection of a proposal requesting a different amount.

Indicative budget	The total indicative budget for this work area is EUR 20.00 million
Type of actions	Research and innovation action (RIA)
Other requirements	The maximum project duration is 36 months.

2.6.1.1 Topic HORIZON-SESAR-2025-DES-IR-02-WA1-1: Transformation to trajectory-based operations

Expected outcomes

To significantly advance the following development actions:

- IR-1-02 **Development of FF-ICE**, including FF-ICE pre-departure enhancement and FF-ICE/R2.
- IR-1-03 Advanced **network trajectory synchronisation in the execution phase**.
- IR-1-04: **Connected and integrated flight management system (FMS), electronic flight bag (EFB) and flight operations centre (FOC) functionalities** for trajectory optimisation.
- IR-1-05: **Dynamic route availability document** (RAD) towards a RAD by exception environment.

Note that IR-1-01 is covered in WA 3 because ATC TBO R&I activities require the development of the next generation of ATS platforms.

This includes advancing the capabilities of the following systems:

- Airborne systems: improved FMSs and EFBs.
- Ground systems: improved FOC/WOC, ATS and NM systems.

Scope (R&I needs)

The following list of R&I needs is proposed as an illustration of the potential project content, but it is not meant as prescriptive. Proposals may include other research elements beyond the proposed research elements below if they are justified by their contribution to achieve the expected outcomes of the topic and are fully aligned with the development priorities defined in the European ATM Master Plan.

- **TBO integration activities and global interoperability**

  This element covers the TBO content integration activities across the programme, including development of the SESAR TBO concept of operations, integrating network, ATC and intra-European (regional) TBO processes, and update of the document based on R&I results (e.g., integration of the IR1 results after the projects conclude). The document must include a human-machine teaming annex describing the ATC TBO automation concepts and the evolution of the role of the human. The development of this annex requires close coordination with WA 3 projects.

At global level, this element covers the international coordination, including in particular support to the TBO related activities of the ICAO ATMRPP panel.

- **ANSP-triggered impact assessment**

  This research element addresses the development of NM capabilities to respond to a request from the ATC ground system to probe in real-time what the impact on the network would be of an ATC clearance that deviated from the agreed trajectory as per the eFPL. It is a support feature that does not deliver clearances but supports the ATC system in the clearance delivery process. This is an extension of the NM network impact assessment (NIA) B2B service, which is already in place today to allow ANSPs to trigger a network impact assessment for a re-routing proposal (RRP) within a pre-defined RRP catalogue.

  This element would benefit from NM-ANSP integrated validation activities addressing the full process from the NM side (covered in WA 1) and ANSP side (covered in WA 3).

- **Unconstrained desired trajectory (UDT)**

  All TBO actors should aim at continuously optimising the trajectory. To do this, the FOC must ensure that the information of the optimum trajectory is made available to NM and the ANSPs, who will take it in consideration. However, the TBO Agreed trajectory represents the accepted flight plan to be taken as a reference for the flight, which often includes ATM constraints and therefore may not represent the trajectory the AU would desire.

  The preliminary flight plan as per the FF-ICE/R1 planning services provides means to share a trajectory with fewer constraints before the submission of the flight plan. The objective of the preliminary flight plan is to support increased dynamicity in the application of constraints (e.g., preliminary flight plans could be used to get early information on traffic demand to assess which RAD measures are the best candidates for waving via the dynamic RAD concept). However, it is expected that the preliminary flight plan will still have some constraints (e.g., constraints that are considered by the AU not to be candidates for removal in the pre-departure phase). In contrast, the UDT should be completely unconstraintned.

  The UDT and preliminary flight plan are compatible and complement each other. Even in the case of flights where the preliminary flight plan has a truly unconstrained trajectory that could be used as a reference for ATM on what the AU would like to fly at the time it was submitted, the preliminary flight plan may not continue to be a valid reference in case the desired trajectory changes due to a re-optimisation process.[79] (e.g., winds different from forecast, turbulence, etc.), because the preliminary flight plan will remain frozen after there is an accepted FF-ICE flight plan.

  The objective of the UDT is to provide a means for the completely unconstrained trajectory desired by the AU to always be available as a reference to ATM. This research element covers:

  - Extension of the eFPL to include the true desired trajectory (completely unconstrained) when the flight plan is filed before departure.
  - The development of an FF-ICE/R2 precursor service to allow the FOC to submit to NM an updated UDT at any time, during the pre-departure or the post-departure phase.

[79] Note FF-ICE/R2 will allow the request for a revised trajectory but will not allow a change to the preliminary flight plan.

The research may investigate alternative means for the AU to provide the UDT in the planning phase and update it during the flight, e.g. the UDT could be provided though the EFB being directly connected to ATC using the applicable air/ground SWIM standard using the connected aircraft concepts.

- The use of the UDT by NM to improve the efficiency of the flight in planning and execution.

In addition to supporting continuous optimisation concepts, the UDT is useful for post-operations performance assessment purposes. The development of performance metrics for assessing flight efficiency based on UDT is also in scope.

Note FF-ICE/R2 has not yet been defined by the ICAO ATM requirements and performance panel (ATMRPP). This element is considered an FF-ICE/R2 precursor. The output of the R&I will contribute to building the global concept.

This element would benefit from integrated validations including the NM and FOC prototypes (covered in WA 1) and the ANSP prototypes (covered in WA 3).

- **FF-ICE/R2 precursor for the revision of the agreed trajectory in strategic execution**

This research element aims at defining the operational processes, services, and systems to support strategic trajectory revisions in execution that can be initiated by either the flight operations centre (FOC), the Network Manager (NM), or local air traffic flow management (ATFM) units. The trajectory revision processes concerned by this element are changes to the trajectory where the point of deviation from the current flight plan is beyond the horizon of interest ATC. This process requires all actors concerned with the revision of the trajectory to have deployed the FF-ICE/R1 services. The solution will provide to airspace users flexibility to reoptimize the trajectories in execution and will increase the network manager trajectory through the anticipation of trajectory changes.

This element covers only the interaction between the FOC and the NM and the intra-European coordination between NM and the concerned ANSPs. It includes the collaborative process from the moment the revision is requested by the FOC, NM or ANSPs to the moment the trajectory is agreed, and the revised flight plan is sent to all concerned actors.

The research needs to establish how the new trajectory will be sent to the flight deck and how the flight crew will implement it; if the new agreed trajectory changes the 2D route of the aircraft, the change means the aircraft will fly a trajectory that is different from what was in the departure clearance (which included the original 2D route):

- The departure clearance is not amended: in this case, the trajectory revision is sent to the flight deck via the dispatcher and either no clearance is delivered (safety case to be developed, e.g. based on comparing ground with air downlinked trajectory or with “check route” CPDLC FANS message where FANS is available) or each ATSU delivers a clearance for the portion of the trajectory within the AoR; or

- The departure clearance is amended: in this case, the clearance for the new trajectory has to be transmitted by ATC using a downstream clearance. In this case, once the new trajectory is agreed by NM and the impacted local ATFM units and the FOC, NM should send a message to the ATSU currently in contact with the flight with the request for the clearance to be provided. This clearance amends the departure clearance.

The planned validation activities must include the validation of the airborne aspects. For cases where the 2D trajectory changes, the validations must address how the new trajectory will be implemented in the navigation system and later flown by the flight crew through either live trials or high-fidelity cockpit simulators, based on one of the two options outlined above or on a different option to be described in the proposal.

This element would benefit from integrated validation covering the network aspects (covered in WA 1) and the ANSP aspects (covered in WA 3).

Note FF-ICE/R2 has not yet been defined by the air traffic management requirements and Performance Panel (ATMRPP). This FF-ICE/R2 precursor can be deployed before full FF-ICE/R1 is available. The end target FF/ICE/R2 process will require all actors concerned with the revision of the trajectory to have deployed the FF-ICE/R1 services. The output of the R&I will contribute to building the global concept. The project must plan adequate resources to contribute to the international coordination activities.

- **FF-ICE/R2 trajectory revision and/or update in execution for arrivals into Europe from non-FF-ICE areas (ASPs that are not eASPs)**

  This research element allows flights arriving in Europe (potentially from non-FF-ICE areas) to benefit to use FF-ICE collaborative processes for the optimisation of the route in European airspace. The element considers the discontinuity in terms of which FF-ICE services are deployed in the ATSUs that the flight will fly through. The objective is to allow the process to take place even when not all the ANSPs between the current position of the aircraft and the point of deviation from the current trajectory are at the same level of FF-ICE deployment.

  The research element addresses one or more of the following processes:

  - eFPL update initiated by the FOC to update the times in the flight plan during the execution phase before the flight enters European airspace. The objective is to provide the European network with a more accurate time for entry into the European area when the flight is still hours away from Europe.

  - Modification of the 2D route in the eFPL for an airborne flight that is inbound the European airspace but has not yet the border of the initial flight plan processing system (IFPS) at the time the revision is made by the FOC. The objective is to allow as an example, a long or medium-haul flight departing from outside the European area and having been re-routed in flight will use this process to update the 2D route in the IFPS zone (IFPZ) hours before entering European airspace, providing NM a more accurate picture of the traffic demand. This is a revision process subject to approval via a trial-request process, but it contains an element (entry point into the IFPZ) that has been modified, so that the point of deviation from the original route is outside of the IFPZ due to the flight has been re-routed by a non-European ATM service provider (ASP). The entry point into the IFPZ would to some extent be a “fait accompli”, while the route in the IFPZ would be subject to approval by NM.

Research aims at determining the boundary between revision and update needs. The research may also investigate the potential benefits of defining a similar process for departures from Europe with destinations out of the IFPZ.

This research element would benefit from simulations integrating airborne prototypes and NM prototypes.

- **Evolution of military flight planning**

  The improved operational air traffic (iOAT) flight plan supports improved civil-military collaboration but is based on the FPL2012. The objective is to build on the iOAT flight plan to define a new FF-ICE-based flight plan and processes for mission trajectory management (including ARES CDM processes and the utilisation of features such as flexible parameters) that moves civil-military collaboration to the next level. The new format and processes should support dynamic coordination between military actors and local DAC actors, specifically national airspace management (ASM) and local air traffic flow & capacity management (ATFCM), throughout CDM on a single 4D Mission Trajectory data, but also provide means for collaboration when military needs do not allow sharing of full set of trajectory data.

- **Integration of flight operations centre (FOC), electronic flight bag (EFB), flight management system (FMS) and ATC platforms**

  The main flight optimisation tool used by pilots today in the execution phase is the FMS, but emerging FOC/EFB applications are challenging this status quo. The development lifecycle of the FMS is slow in comparison, due to the strict software development conditions required by its flight path management capabilities. In contrast, FOC-EFB[80] tools can be rapidly developed, potentially including the use artificial intelligence (AI) tools whose certification for the FMS would be very challenging.

  The EFB-optimised trajectories may include speeds different from those planned by the FMS, which need to be implemented by the pilot by overriding FMS speeds. In some cases, this is done by manual entry into the FMS, while in other cases the flight crew enters the optimised longitudinal or vertical speeds on the flight control unit (FCU) / mode control panel (MCP). The EFB may also recommend that descent start before or after the FMS TOD downlinked via ASD-C, which is the point ATC expects descent to start if the flight is cleared to “descend when ready” or “descend at own discretion”. The use of the EFB for flight optimisation by flying selected or manual instead of in managed mode reduces the predictability of the flight for the ATM system.

  The objective of this concept element is to develop full FOC-EFB-FMS-ATM integration during the flight execution. This may include, for example:

  - The seamless integration in the FMS of optimisation constraints calculated by FOC-EFB tools[81]. The optimisation constraints will be considered by the FMS as long as they are consistent with the ATC constraints and ATM planning constraints. The

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[80] EFB in this context refers to any COTS or purpose-built on-board computer without flight-path control capabilities that handles trajectory data either directly or through a connection to FOC computers. EFBs can be portable or permanently installed in the cockpit. In contrast, FMS is an on-board computer with flight path control capabilities.

[81] Optimisation parameters calculated by the EFB and entered in the FMS are referred to as optimisation constraints because they constrain the way the FMS can plan the flight path.

element also includes support for flight crews to request an amendment of the ATC clearance where needed (e.g., if the FOC-speed is outside the +/- 5% from the flight plan speed, if they need to request a different flight level for the cruise, or a different rate of climb or descent, etc.) or a revision of the FF-ICE flight plan (in an FF-ICE/R2 revision process) if appropriate (strategic change to the trajectory in execution).

  - The direct connection from the FOC or the EFB and ATC systems as an alternative way to route FMS trajectory information from the FMS to ATC systems, and potentially additional trajectory information elements, e.g. aircraft equipped with Revision A could downlink Revision B elements via the EFB. The FMS trajectory information could be transmitted from the FMS to the EFB or be calculated by the EFB through an FMS-twin service (hosted on-board at the EFB or on the ground at the FOC[82]). The FMS-twin could allow a more rapid implementation of new trajectory exchange messages than if an update of the FMS were required, e.g. new interrogation messages from ATM to the aircraft that are not in ATS B2 standards for ATM to interrogate the aircraft systems on how the trajectory would change under certain hypotheses. Research shall investigate the feasibility and acceptability of this solution. Please note that it is not foreseen that the ATC to EFB connection be used for the transmission of ATC clearances (i.e. routing of ADS-C information via the EFB to ATC is in scope, but routing of CPDLC messages through the EFB is out of scope).

  - EFB/FOC developments to support the A/G exchanges between the FOC and the flight deck during the execution phase for both A/G FF-ICE/R2 negotiations for the update of the trajectory during the execution phase beyond the horizon of interest of ATC and A/G exchanges in support of the ATC TBO concepts.

  Note that trajectory optimisation tools at the FOC, the EFB or the FMS are covered in WA 5-3 “Environmentally driven trajectory planning”, while the integration of FOC-EFB-FMS is covered in this element. A key objective of this element is to avoid the increased use of advanced FOC-EFB trajectory optimisation tools results in a reduced use of FMS managed mode.

  The EFB connection to ATC systems is expected to use the applicable air/ground SWIM standard. The research must investigate if the update of the standard currently under development (building on the work of MIAR SESAR solution 0335 “SWIM TI purple profile for air/ground safety-critical information sharing”) is appropriate to cover each of the use cases that are investigated, or a further update is needed.

- **Connected aircraft Network TBO (airline information services domain (AISD))**

  This element addresses the development of AISD flight-deck connectivity to support the connection from the flight deck to:

  - NM/local ATFM units, to participate in the FF-ICE/R2 trajectory negotiations (flight-deck acting as its own FOC) or trajectory negotiations.

[82] Note that even if the FMS-twin located at the FOC, there is no plan for an extra connection from the FOC to ATC ground systems, and hence the connection from the FMS-twin to the ATM systems would have to be routed via the EFB.

- The FOC, in support of the TBO FOC trajectory negotiations (so the negotiation happens between the FOC and NM/local ATFM units): this element covers the FOC coordination with the flight deck).

- **Increased dynamicity in the application of RAD/LoA constraints**

  The objective of the research is to allow for increased dynamicity in the application of one-size-fits all constraints, be them pre-departure RAD measures (with or without a corresponding LoA) or LoA constraints without a corresponding RAD measure. This concept supports the evolution from the current paradigm or managing traffic flows to the tailored management of individual flights with the objective of increasing flight efficiency. This will pave the way for the target RAD by exception concept, where the RAD is reduced to a minimum, and the AU typically submit the flight plan with the unconstrained desired trajectory (UDT). In a RAD-by-exception environment, NM replies to the flight plan submission with the UDT with a proposed trajectory where the constraints that are strictly necessary have been applied, which the AU can either accept or make a counterproposal to.

  The research should address the applicability of the increased dynamicity all along the trajectory lifecycle:

  - Automation support for the provision of the Preliminary flight plan (PFP) by AU and processing by NM and local ATFM units.

  - In the pre-departure phase, up to 2-3 hours before departure, FMP automation tools should identify which RAD measures (with or without a corresponding LoA) could be waived based on the prediction of traffic demand developed by before flight plans are submitted combined with information on preliminary FF-ICE flight plans when available.

  - Shortly before departure, when the demand is better known, automated tools could support the identification of individual flights with an already accepted flight plan that is subject to a RAD constraint for which the RAD constraint could be removed. In some cases, it may be possible to remove a RAD measure for a full traffic flow. The concerned AU would be informed of the improvement opportunity, and if interested they would revise the flight plan as per the FF-ICE processes.

  - In the strategic execution phase, FMP automation should continuously look for RAD waving opportunities. When an opportunity is identified, the airline should be informed and if interested they should revise the flight plan as per the FF-ICE revision process.

  - In the tactical execution phase, ATC automation should identify the individual trajectories or traffic flows for which RAD/LoA constraints could be waived, coordinate the new improved trajectory between ATC sectors or across ATSU borders (typically through an approval-request process) and deliver the ATC clearance to the aircraft. In some cases, a positive network impact assessment will be needed to ensure no negative downstream impact. The research may investigate whether this process could be reversed, at least for some routes, e.g. in the vertical dimension, even with a RAD or LoA measure in force, ATC does not issue the clearance for the constraint- for example an early descent to cross the border with the next ATSU or sector at or below a certain level – unless the ATC automation shows an alert requiring the clearance.

The research may address concepts to increase the predictability for the AU of which RAD measures are likely to be applied, e.g. by providing a catalogue of conditions (times, days. MET conditions) in which the RAD measure is more likely to be applied (conditional RAD).

Note there is on-going research on PFP, LoA constraint management and dynamic RAD in the ongoing Network TBO and HERON projects.

- **Develop a digitalised letters of agreement (LoA) repository and their provision to NM**

  In order to deploy the Network 4DT (4D Trajectory) CONOPS, the objective of the research is to create an interactive digitalised repository of LoAs to be embedded in the Network Manager (NM) systems in order to allow for an improved processing the submitted flight plans. Electronic copies of LoA shall be provided to the NM by ANSPs in the strategic phase and maintained as appropriate. For this purpose, NM needs to establish and closely follow-up the process of LoA provision, as well as the provision of subsequent amendments and modification. The LoA effect is implemented through the addition of 4D points to the list of ordered elements within the NM Trajectory. Digital LoAs will be shared with all relevant actors.

  This research elements covers in particular the provision of LoAs to NM. NM needs to establish and closely follow-up the process of LoAs provision and as well as the provision of subsequent related amendments and modification.

Specific minimum requirements for this topic:

Integration of flight operations centre (FOC), electronic flight bag (EFB), flight management system (FMS) and ATC platforms: consortia for this topic shall:

- Either include an established FOC system manufacturer or provide evidence that the consortium has the operational and technical capability to build the FOC prototypes required for the research at the required maturity level.
- Either include an established ATS system manufacturer or provide evidence that the consortium has the operational and technical capability to build the ATS system prototypes required for the research at the required maturity level.
- Either include an established FMS system manufacturer or provide evidence that the consortium has the operational and technical capability to build the FMS system prototypes required for the research at the required maturity level.

2.6.2 Work Area 2: Transition towards high performance of air-ground connectivity (multilink)

The working area covers the integration of non-safety, commercial links into a hybrid communication infrastructure for ATM safety communication needs, the complete development of successor(s) to VHF datalink mode 2 (VDLM2): L-band digital aeronautical communications system (L-DACS), hyper-connected ATM, and satellite communications covering civil-military dual use (considering both interoperability and performance based approaches). This working area also covers innovative ways to support intelligent data pre-processing and integration, both on ground and on board the aircraft for air/ground exchange of data (e.g., meteorological data, etc.).

Specific conditions for WA2	
Expected EU contribution per project	The SESAR 3 JU estimates that a maximum EU contribution of EUR 7.00 million would allow these outcomes to be achieved. Nonetheless, this does not preclude the submission or the selection of a proposal requesting a different amount.
Indicative budget	The total indicative budget for this work area is EUR 14.00 million
Type of actions	Research and innovation action (RIA)
Other requirements	The maximum project duration is 36 months.

2.6.2.1 Topic HORIZON-SESAR-2025-DES-IR-02-WA2-1: Transition towards high performance of air-ground connectivity (multilink)

Expected outcomes

To significantly advance the following development actions:

- IR-2-01: Complete development of **successor(s) to VHF datalink mode 2** (VDL2): L-band digital aeronautical communications system (LDACS), hyper-connected ATM, and satellite communications covering civil-military dual use.
- IR-2-02: **Aircraft as a sensor**, including transmission of humidity information to ground, etc.

This includes advancing the capabilities of the following systems:

- Airborne systems: aircraft sensors.
- Air-ground systems: air-ground communication links.

Scope (R&I needs)

The following list of R&I needs is proposed as an illustration of the potential project content, but it is not meant as prescriptive. Proposals may include other research elements beyond the proposed research elements below if they are justified by their contribution to achieve the expected outcomes of the topic and are fully aligned with the development priorities defined in the European ATM Master Plan.

- **Hyper Connected ATM**

  Research aims at completing the delivery of hyper-connectivity solutions that allow the use of non-safety-approved commercial public air-ground communication links and networks (e.g., 5G mobile networks, commercial Ku/Ka-band satellite communication, etc.) as a complement to legacy safety links, whilst meeting the required safety, security, and performance standards for safety-related air-ground communications. The proposed solution will leverage state of the art “at hand” commercial radio infrastructure already deployed to serve in-flight connectivity for passengers, use them ‘as they are,’ and aim at enhancing some end-to-end cockpit communications general performance (e.g., bandwidth, latency, etc.) in nominal conditions.

Research shall consider an interim precursor scenario integrating the hyper connected ATM concept into the existing environments (ACARS and ATN/OSI), but also a target scenario considering the full integration of the hyper connected concept within an ATN/IPS environment and the future communication infrastructure (FCI). To complete TRL6, research activities shall consider the execution of live flight trials involving test aircraft with on-board pre-industrial prototypes. These live flight trials can be performed in Europe and may be extended across continents for addressing global interoperability aspects.

Research shall address the alignment with European Space Agency (ESA) Iris programme research initiatives, which are addressing the use of Ka band satellite technologies for safety critical communication.

Note that work on this research element is on-going under project FCDI SESAR solution 0339 “Hyper Connected ATM Precursor” and SESAR solution 0340 "FCI Services - IPS Enhancements".

The hyperconnected ATM concept is based on the use of public networks for aviation safety-critical data traffic. As safety-critical data traffic increases, VDLM2 may not have the capability to back-up the whole safety-critical data traffic, which increases the need for multilink, including making use of non-aviation networks. Hyperconnected ATM is a set of mechanisms that allows making use of both safety and non-safety links (e.g., AOC data could go over non-safety critical links). Research shall consider situations in the safety and security cases such as avoid single point of failure for two different communication providers (that may have back-up contracts between them), or simultaneous failure of the services of all satellite communications due to atmospheric phenomena or cyber-attack, etc. Since hyperconnected ATM uses public networks, research shall consider advanced techniques and approaches to enhance cybersecurity to address new attack models/vectors that may stem from the new scenario. Also, research shall address potential conflicts with spectrum frequency allocation.

Research should also investigate applicability to HAO.

- **Complete the development of digital voice CONOPS and technical capability**

  The research area addresses the development of the technical capability to exchange digital voice services. Digital voice is foreseen to replace VHF radio completely in the long term in all operational environments: continental (en-route (flight-centric or with geographic sectors, continental high and low density), TMA and tower (TWR), including ground and platform control) and oceanic. The proposed technical solutions should be configurable to support both party line and point-to-point ATS-pilot communication. The research’s initial step will consist of describing the applicable operational use-cases for digital voice (i.e., CONOPS).

  The research area covers the development of the digital voice capability for L-band Digital Aeronautical Communications System (L-DACS), Satcom and hyper connected ATM solution. Besides interoperability, RF spectrum supportability needs to be addressed with military systems including military systems providing service to civil aircraft. To complete TRL6, research activities shall consider the execution of live flight trials involving test aircraft with on-board pre-industrial prototypes. These live flight trials can be performed in Europe and may be extended across continents for addressing global interoperability aspects. On L-DACS digital voice capability, research shall consider the work done under SESAR solution PJ.33-W3-02 “L-DACS digital voice capability”, which achieved TRL4 in SESAR 2020.

- **Aircraft as a sensor**

  Research aims at improving flight safety and efficiency by enriching usual MET information sources with MET data from on-board sensors (e.g., icing, hail, turbulence, wind, humidity sensors and temperature) provided via data link services. The service could be then consumed by ground systems (e.g., trajectory predictors) in real time. This will also deliver environmental benefits by reducing CO_2 and non-CO_2 emissions (e.g., high precision humidity sensors/data are an essential ingredient for precision of contrails prediction models, and consequently for mitigation of contrails formation). Research areas may include very short-range weather forecasts based on aircraft meteorological data relay (AMDAR) and observational data assimilation (e.g., predicted wind, wind shear, etc.) during the approach and landing phases, Mode-S EHS, new possibilities emerging from ADS-C, etc., and their distribution to ground, additional enabling sensors for non-CO_2 emissions (e.g., lidars, etc.).

  In addition to information from onboard sensors, pilots receive updates in various formats via datalink including simple text messages, graphical products, and satellite images. These inputs cover different timeframes, ranging from past observations to predictions for the next several hours. It falls to the pilot to organise and geo-reference these data, and temporarily build a mental picture as fast as possible. Research shall address innovative solutions to support intelligent data pre-processing, smart filtering, and integration and fusion, both on ground and on board the aircraft for the two-way exchange of data collected by the vehicle's own sensors as well as satellite based and terrestrial navigation (e.g., exploiting multi-constellation double frequency GNSS), surveillance and weather systems. The research shall consider the novel avionics and flight crew procedures required to use this information. Downlink and uplink of weather parameters (pressure, temperature, wind speed and direction), turbulence, space weather, icing considerations and contrail related information (e.g., air humidity) shall be addressed.

  The research will contribute to EUROCAE WG-76 and RTCA SC-206 MET datalink standardisation, and ICAO is also developing standards for turbulence and space weather which could be downlinked or uplinked via a SWIM purple profile service. Research shall consider the work done under solution PJ.14-W2-110 "Aircraft as an AIM/MET sensor and consumer".

  The research scope also covers the development of aircraft-centric sensing technologies able to detect obstacles on or near the runway or potential runway incursions during take-off and landing operations, including enhanced traffic surveillance technologies able to mitigate low ADS-B updates rates from aircraft on ground, or pilot aids for prediction of other-aircraft intent based on traffic movement monitoring and recognition of ATC voice and future datalink-based clearances.

  Research may also include the transmission of the runway condition code (RWYCC) (partially delivered under SESAR2020 PJ.02), both for air and ground sub elements. Among the research elements, further works on air-ground synchronization is required (e.g., downlink and integration of on-board braking action computation system (OBACS) data).

  This research may also cover the development of innovative LIDAR-based ATM applications.

- Pitot-static systems, which are traditionally used by flight avionics as air-data technology, present limitations related to failure modes, environmental sensitivity, etc. Research aims at developing LIDAR based solutions that, applying a different approach (based on optical means), meet or exceed the performance of traditional pitot-static systems, overcome the limitations mentioned above and support requirements for all weather and all flight phases.

- The available technologies/procedures that help the pilots recognising the presence and severity of icing conditions (e.g., weather forecast, operational procedures, etc.) are limited and they are not able to assess the severity of icing conditions. Research aims at developing LIDAR based sensors able to detect the particles present in the vicinity of the aircraft, identify their type (e.g., ice, volcanic ash, sand, dust, etc.), measure their size distribution and mass concentration in the air and quantify the severity of icing conditions.

These solutions aim at improving safety. In addition, downloading more accurate air data information from the aircraft will also improve weather models and non-CO_2 models resulting in efficiency and environmental benefits.

The development of the services to aggregate the data downlinked from the aircraft, its fusion with data from ground sensors (e.g., LIDAR, ground cameras, etc.) and the distribution of the associated improved predictions (e.g., climate MET services) and corresponding business models is also in scope.

Specific minimum requirements for this topic:

- Proposals addressing Hyper Connected ATM and digital voice capability must aim at completed delivery at TRL6, no deviation will be accepted.

- Civil-Military systems spectrum compatibility shall be addressed.

2.6.3 Work Area 3: Future En-Route and TMA ground platforms

The working area targets the transformation of both cruise and climb/descent flight phases into highly automated environments enabled by full air/ground integration. The aim is to implement a service-oriented, cloud-based model that allows dynamic capacity adjustment to meet airspace user demands. Focus areas include enhancing cyber-resilience, leveraging artificial intelligence for flight path optimisation, and promoting civil-military collaboration for seamless airspace management.

Specific conditions for WA3	
Indicative budget	The total indicative budget for this work area is EUR 113.00 million
Type of actions	Research and innovation action (RIA)
Other requirements	The maximum project duration is 36 months.

2.6.3.1 Topic HORIZON-SESAR-2025-DES-IR-02-WA3-1: Next generation ATS platforms for en-route and TMA operations

Specific conditions for WA3-1	
Expected EU contribution per project	The SESAR 3 JU estimates that a maximum EU contribution of EUR 31.00 million would allow these outcomes to be achieved. Nonetheless, this does not preclude the submission or the selection of a proposal requesting a different amount.
Indicative budget	The total indicative budget for this topic is EUR 93.00 million

Expected outcomes

To significantly advance the following development actions:

- IR-3-01 **Next generation ATC platform** addresses the next generation ATC platform, fully leveraging aircraft capabilities. This includes supporting a data-sharing service delivery model, resilient integrated CNS/MET as a service, traffic synchronisation, etc., accommodating the specific needs of the military, innovative air mobility (IAM), higher airspace operations (HAO), and U-space, etc.
- IR-3-02 **Artificial intelligence** (AI) capabilities enabling the next generation platforms.
- IR-3-03 **Cyber-resilience and cyber-security** capabilities enabling the next generation platforms.
- IR-3-04 **Separation management** for high levels of automation.
- IR-3-05 **Demand capacity balancing (DCB) and airspace configuration concepts** for high levels of automation.
- IR-3-06 Future **human – machine teaming**.
- IR-3-07 **Ground capabilities for reducing ATM environmental footprint**. This includes climate-optimised trajectories including non-CO_2 effects (e.g., contrails), environmentally optimised climb and descent operation, advanced required navigation performance green approaches, dynamic allocation of arrival and departure routes considering noise and local air quality, green ATC capacity concept, flexible eco-friendly clearances, wake energy retrieval (WER)[83], integration of sustainable aviation fuels (SAF) and zero emissions aircraft, environmental performance dashboards, etc.
- IR-1-01 **Integrated air/ground trajectory management** based on ATS-B2 including the extension for lower airspace and airport surface.

This includes advancing the capabilities of the following systems:

- Ground systems: core ATS platforms for en-route and TMA operations.

Scope (R&I needs)

[83] In order to avoid content duplication, wake retrieval energy (WER) description is provided in the topic WA5-3, which is addressing the development action IR-5-04

Research aims at developing the next generation of ATS platforms both for en-route and TMA environments, considering state-of-the-art ground technologies while leveraging innovative solutions and new aircraft capabilities aiming to achieve level 4 of automation as outlined in the Master Plan and by considering a Trustworthy AI approach. The targeted ATS platforms shall enable the following capabilities:

- Ensuring that all flights/missions (crewed or uncrewed) operate in a way that maximises, to the fullest extent, aircraft capabilities to reduce the overall climate impact of aviation (CO_2 and non-CO_2) (see detailed R&I needs below).
- Ensuring that each flight trajectory is optimised considering the individual performance characteristics of each aircraft, user preferences, real-time traffic, local circumstances, and meteorological conditions throughout the network. This optimisation shall be systematic, continuous (from planning to execution phase), and extremely precise (see detailed R&I needs below).
- Potential conflicts between trajectories or traffic bottlenecks are resolved much earlier than today, bringing safety benefits.
- Service providers can dynamically and collaboratively scale capacity up or down in line with demand by all airspace users. These capacity adjustments are implemented in real time and ensure optimal and efficient dual (both civil and military) use of resources at any moment across the network (airspace, data, infrastructure, and human-machine teaming).
- End-points, data connection and ecosystem (considering civil-military needs) are cybersecure thanks to the enhancement of information security such as, but not limited to, strong identification, authentication and integrity. Post-quantum cryptography (PQC) algorithms.[84] should be considered where appropriate. Research shall consider the on-going work by ICAO on the international aviation trust framework (IATF), which aims at developing standards and harmonised procedures for a digitally seamless sky and dependable information exchange between all parties.
- The continuous optimisation of every flight/mission from gate to gate is systematically guaranteed thanks to high connectivity between air-ground and ground-ground components.
- The human operator is performing only the tasks that are too complex for automation to handle, teaming up with automation (see automation roadmap of the Master Plan and detailed R&I needs below).
- Voice communication is no longer the primary way of communicating and most routine tasks should be managed through machine-to-machine applications.
- To enable TBO Phase 3 in a highly automated ATM environment in accordance with the TBO and automation roadmaps in the ATM MP (see detailed R&I needs below).

Specific minimum requirements for this topic:

[84] https://digital-strategy.ec.europa.eu/en/library/recommendation-coordinated-implementation-roadmap-transition-post-quantum-cryptography.

Consortia for this topic shall include:

- At least three ANSPs.
- Either an established ATS system manufacturer or provide evidence that the consortium has the operational and technical capability to build the ATS system prototypes required for the research at the required maturity level.

The proposed target architecture shall be aligned with the service delivery model outlined in the Master Plan for a typical ACC.

Detailed R&I needs to enable TBO phase3:

The following list of detailed R&I needs is proposed as an illustration of the potential project content, but it is not meant as prescriptive. Proposals may include other research elements beyond the proposed research elements below if they are justified by their contribution to achieve the expected outcomes of the topic and are fully aligned with the development priorities defined in the European ATM Master Plan.

For completing TRL6, proposals may need to consider the execution of integrated validation activities involving the output of one or more projects in WA1 and/or WA5. Proposals shall describe these activities in separate work package(s) and identify associated risks in case the other project(s) are not finally awarded.

- **ATC TBO contribution to TBO concept development**

  At European level, this element covers the contribution to the European TBO concept of operations (developed by WA 1), including the ATC TBO aspects and ATC human-machine teaming automation concepts.

  At global level, this element covers the international coordination, including in particular supporting the ATC TBO related activities of the ICAO ATMRPP and ICAO ATMOPS panels.

- **Automated downstream ATC clearance via ATS B2 CPDLC in en-route.**

  This element covers the uplink, via ATS B2, of a revised 2D trajectory where the point of divergence from the current trajectory is beyond the sector where the aircraft currently is. The request for the clearance to be sent to the aircraft will come from a downstream ATC sector in the same ATSU or from a downstream ATSU. In the cross-ATSU-border case, the uplink will be done from the current ATSU (i.e. the current ATSU is relaying the clearance on behalf of the downstream ATSU)[85].

  The target concept is for this uplink to be done automatically by the ATC systems without the intervention of the human operator currently controlling the flight or even his/her awareness (automation level 4) but in a first step a lower level of automation may be considered. The uplinked trajectory must either connect to the original trajectory in a downstream point or

[85] In the cross-ATSU-border case, for the downstream clearance to be uplinked directly by the downstream ATSU, the aircraft would have to have two active CPDLC connections (one to the current ATSU and another one to the downstream ATSU). The SESAR concept does not consider the double active connection option.

provide a new route all the way to the destination airport. Note the trajectory of the aircraft does not change the trajectory in the current sector.

This element may require the ATSU systems to be able to uplink clearances beyond their usual area of interest, potentially all the way to a distant destination airport. The correct implementation in the FMS active plan of the uplinked 2D trajectory will be verified by comparing it to the ADS-C EPP. The comparison must consider the whole portion of the revised trajectory, including the part that is beyond the area of responsibility of the current ANSP.

Operational issues with FANS 1/A downstream clearances in oceanic airspace have been raised at the ICAO ATM operational panel (ATMOPS) (e.g., with aircraft incorrectly loading the new route in the FMS (skipping points)). The research element also covers the mitigation of the risk for similar operational issues with ATS B2 (e.g., based on conformance monitoring against the EPP) and coordinate with the SESAR 3 JU to liaise with the ICAO ATMOPS panel if needed.

This element would benefit from air-ground integrated validation activities integrating the ground prototypes (covered in WA 3) and the airborne prototypes (covered in WA 5). For the cross-ATSU-border case, the research should validate the case where two ATSUs have systems from different vendors.

- **Use of CPDLC v2/v4 in the TMA and extended TMA.**

  This research element covers the development of the ATC ground systems and flight-deck (HMI, potentially including digital assistants, and avionics, including extension of push-to-load capabilities if needed), in support of the extension of the use of CPDLC to the lower airspace (below the current mandate, addressing in particular below FL245) to allow the uplink and push-to-load of ATC clearances in the extended TMA and TMA (including approach) for a closed lateral trajectory revision (for separation and/or to accommodate path extension/path shortening), speed instructions, altitude clearances and clearance for approach. Speed instructions will be generated by the ground system (e.g. based on ML algorithms based on the SESAR optimised runway delivery tool). The expected automation level may vary between 2 and 4 depending on the environment and conditions (e.g., night traffic, low density) and the type of instructions (i.e., 2-4 for speed instructions, 2 for lateral clearances).

  This element would benefit from air-ground integrated validation activities integrating the ground prototypes (covered in WA 3) and the airborne prototypes (covered in WA 5).

- **Automatic cross-border STAR ATC clearance uplink service.**

  This research element aims at anticipating the STAR clearance and the delivery of expected runway and approach procedure information to the flight deck. The TMA will first check the STAR and expected runway and approach procedure in the EPP (received through G/G coordination) against the STAR that is allocated in the system. In case of discrepancy the arrival TMA ATSU will directly uplink the STAR clearance and runway and approach procedure information over CPDLC to the aircraft (if the ATSU in communication with the aircraft) or send a request to the adjacent upstream ATSU with a request for the correct STAR clearance and to be uplinked. The automatic STAR clearance will only include a clearance to follow the 2D STAR until the clearance limit. For clearances for descent to be delivered by the upstream ATSU, the usual cross-border coordination procedures will apply. For the cross-ATSU-border case, the research should validate the case where two ATSUs have systems from different vendors.

The research may also cover the uplink of the STAR by an ATSU that does not have a common border with the arrival TMA. In this case, the message from the arrival TMA requesting the uplink may be sent directly to the ATSU or via NM. The target concept is for the uplink of STAR to be done at any time and as early as possible, e.g. even when the flight is still on the ground at the departure airport.

The information on the STAR and request to uplink and confirmation that the uplink has taken place will be done using ED-254 messages over SWIM.

Note there is a synergy between this element and the ongoing work on dynamic arrival route structures in ongoing project GALAAD, as the automatic uplink of STAR could support the implementation of GALAAD's concept.

This element would benefit from air-ground integrated validation activities integrating the ground prototypes (covered in WA 3) and the airborne prototypes (covered in WA 5).

- **ANSP-triggered network impact assessment.**

  The research element addresses the development of capabilities that allow the ATC ground system to probe in real-time what the impact on the network would be of an ATC clearance that deviated from the agreed trajectory as per the eFPL. It is a support feature that does not deliver clearances but supports the ATC system in the clearance delivery process. This is an extension of the NM network impact assessment (NIA) B2B service, which is already in place today to allow ANSPs to trigger a network impact assessment for a re-routing proposal (RRP) within a pre-defined RRP catalogue. This element allows the same to be done for any RRP (not necessarily pre-defined) and for vertical changes:

  - In the vertical domain, the concept applies when ATC receives a request for a cruising flight level that is different from the flight plan cruising level, or when the planned cruising flight level is not available (due to it being occupied by another aircraft in separation conflict) and ATC has a choice to clear the aircraft to at least two other flight levels (typically the one above or the one below). This will be integrated in the overall conflict detection and resolution processes.

  - The concept may also be useful for ATC to probe before providing a direct routing (DCT) clearance that significantly shortens the flight time (e.g., over three minutes). This use case is expected to be of less interest than the vertical change use case, because DCT clearances that shorten the flight time significantly enough to make the network impact assessment worthwhile are rare (because there is a very low probability that such small changes will have a DCB impact downstream). The exception may be, for example, in case of an early release of an airspace reservation that allows a DCT that saves a significant amount of track miles.

  Research may address more advanced what-else capabilities for pre-defined scenarios (evolution of current NIA) or for more general use cases (ANSP-triggered network impact assessment).

  This element would benefit from NM-ANSP integrated validation activities addressing the full process from the NM side (covered in WA 1) and ANSP side (covered in WA 3).

- **Enhanced ATC vertical clearances with intermediate constraints**

  When an aircraft needs to climb or descend in busy airspace, there will often be separation conflicts along the way. ATC often manages this by providing a clearance for climb/descent to an intermediate level, and later reassessing the separation conflicts before issuing a new clearance. With the EPP, ATC gets a better idea of what the climb or descent profile of a specific aircraft will be. This reduces the uncertainty but there is no guarantee that the aircraft will execute the trajectory as predicted by the EPP. When the predicted separation with other aircraft is close to the minimum 5NM/1000 ft., it is necessary to ensure it will be respected. This concept allows ATC to uplink an ATS B2 clearance climb/descent clearance with one or more constraints to cross certain intermediate waypoints at or above, at or below or precise at a certain level or between two specified levels. The concept expands the use of vertical clearances to the more complex use cases, i.e. beyond the clearance to start descent at the FMS TOD or climb to reach cruising altitude at the FMS TOC.

  The element covers the ground and airborne aspects, including further development of on-board procedures and avionics to for improved management of vertical constraint. The research should investigate both manual and push-to-load clearances, noting that the target concept is that all vertical clearances are push-to-load, but as an interim concept some complex vertical clearances with intermediate constraints may be loadable only manually (due to limitations of the ATS B2 standard). On the ground side, the correct loading of the vertical clearance on the FMS should be verified through the ADS-C data, potentially with different time-outs for clearances that are push-to-load and those that are initially loadable in the FMS only via manual input from the flight crew. The research considers ATS B2 Revision A or above.

  This element would benefit from air-ground integrated validation activities integrating the ground prototypes (covered in WA 3) and the airborne prototypes (covered in WA 5).

- **Leveraging ATS B2 in support of increased automation levels**

  Research aims at exploiting ATS B2 capabilities to support increased automation levels in en-route and TMA environments, including, for example:

  - The automatic uplink of AMAN-generated speed advisories, e.g. translate TTL/TTG or AMAN planned times into speed advisories and their automatic uplink to the aircraft.
  - The provision of tactical separation assurance (i.e., separation management activities when aircraft is in the AoR) leveraging ATS-B2 beyond what it is covered by the strategic deployment objective SDO #5. This includes the identification of potential conflicts in the AoR, the automatic selection of resolutions considering also downstream constraints, and the facilitation of all required coordination with upstream and downstream sectors. The research may include Human-AI teaming concepts, including the development of new HMI features to streamline the human operator planning activities.
  - The scope also includes the provision of planning separation assurance when aircraft are already within the Area of Interest (AoI), extending the AoI up to 30 minutes before the Area of Responsibility (AoR). This research focuses on automated conflict identification, resolution selection, and transparent coordination, as well as traffic

expedition and environmental optimisation during the execution phase. The research may include Human-AI teaming concepts.

- The automatic identification of potential conflicts before the aircraft is in the AoR, the automatic selection of potential resolutions considering also downstream constraints, and the transparent coordination among impacted sectors and the provision of downstream clearances to solve the conflict before the aircraft enters in the AoR. The research may include Human-AI teaming concepts.

- The use of CPDLC v2 clearances without ATCO validation (e.g., delivering downstream clearances without current sector validation (e.g., speed instructions for XMAN, @D route revision, speed optimisation (ATS B2 Rev A and Rev B), the automatic uplink of AMAN-derived speed constraints, etc.).

- The delivery of speed advisories (note that an advisory is not a clearance) to aircraft not currently within control of the ACC applying the speed advisories, e.g. for XMAN purposes.

- “Silent” radio, where the pilot does not call if between sectors based on ATS B2 Rev B downlink of the selected VHF frequency. This may include an interim concept based on ATS B2 Rev A, which includes the automatic silent transfer on the ATC side under certain conditions, but the pilot still calls between sectors. The objective is to reduce the need of check-in radio calls every time the flight is transferred to a new sector within an ATSU or to another ATSU.

- Automatic uplink of speed constraints to succeeding aircraft in the cruise phase: the system automatically calculates and uplinks Mach number constraints for aircraft that will fly on the same route over a long period of time to avoid catch-up situations. The system should calculate the speed constraints to minimise overall fuel burn considering equity principles to not systematically penalise aircraft with a lower fuel consumption.

- Automatic uplink of Mach number or indicated airspeed (IAS) constraints to aircraft descending on the same route to ensure the separation gap be maintained during the descent, thereby reducing the need for intermediate vertical constraints in the descent. Note that many FMS versions do not manage speed constraints when defined as a Mach. A "constant Mach segment" feature exists in most FMS, allowing to fly at a constant Mach in cruise between 2 specified waypoints, but this does not exist for Descent (only IAS constraints are managed However, aircraft with such limitation for flying Mach number constraints with the FMS can still execute such instructions using FCU/MCP Note that there is on-going work under projects ATC-TBO and JARVIS.

This element would benefit from air-ground integrated validation activities integrating the ground prototypes (covered in WA 3) and the airborne prototypes (covered in WA 5). For elements requiring cross-ATSU-border coordination, the research should validate the case where two ATSUs have systems from different vendors.

- **Highly automated ATC**

In this concept ATS B2-equipped flights are never in contact with a human operator via either voice or CPDLC based while the traffic situation remains within a pre-defined scope, using either a general or a selective approach; In both the general and selective approaches, there is no human operator directly monitoring the system actions; when an aircraft is controlled by the system they will be instructed to monitor a frequency, but the flight crew requests should come via CPDLC and will not be directly processed by a human operator unless the ground system requests human supervision (in accordance with level 4 the automation roadmap):

- In a general approach, all aircraft in a sector or group of sectors are controlled by the system so long as the scenario remains in its pre-defined scope, e.g. the defined scope may require that all aircraft in the scenario having a specific equipage and being separated from each other by either 1000 ft (vertically) or XX NM (laterally) and may exclude specific traffic flows. Whenever the pre-defined scope conditions cease to be true for all aircraft, e.g. one non-equipped aircraft entering the sector or two aircraft get closer than 1000 ft or XX NM, then the system will request the human operator to take charge of the whole scenario, i.e. the human operator relieves the ATC system.

- In a selective approach, the human operator and the ATC system work together within the same sector or group of sectors, so that the ATC system is in charge of controlling the aircraft that fulfil the conditions within a pre-defined scope. This concept builds on the SESAR attention guidance "fade-out algorithm" solution (PJ.10-W2-96 AG), taking it a step further: the selected aircraft are not just faded-out, but completely under the control of the system. When an individual aircraft ceases to fulfil the pre-defined scope conditions, the system will request the human operator to take the individual aircraft under control, while the system continues to control the aircraft that are still in the pre-defined scope.

This element would benefit from air-ground integrated validation activities integrating the ground prototypes (covered in WA 3) and the airborne prototypes (covered in WA 5).

- **ANSP contribution to and use of network trajectory service**

  This research element covers:

  - Definition and validation of new updates from ANSPs to NM via FSA.
  - Reception by ANSP systems of NM trajectory and its integration in the trajectory used by local ATFM unit systems and/or the trajectory used by the AMAN.

- **Unconstrained desired trajectory (UDT)**

  All TBO actors should aim at continuously optimising the trajectory. The objective of the UDT is to provide a means for the completely unconstrained trajectory desired by the AU to always be available as a reference to ATM. This research element covers:

  - The use of the UDT by the local ATFM units to improve the efficiency of the flight in planning and execution.
  - The use of the UDT during the execution of the flight by ATC to facilitate the continuous and precise optimisation of all trajectories. Note that the provision of ATC

clearances that are not consistent with a current RAD measure or a LoA with an impact on a downstream ATSU will always require coordination with the relevant actors (cross-border if only one downstream ATSU is affected, or via an ANSP-triggered network impact assessment if the change affects more than one downstream ATSU). If a network impact assessment is required, the ATC system should trigger it automatically.

In addition to supporting continuous optimisation concepts, the UDT is useful for post-operations performance assessment purposes. The development of performance metrics for assessing flight efficiency based on UDT is also in scope.

This is a support feature that does not deliver clearances but supports ATC in the clearance delivery process. Requires participation of NM, ANSPs and FOC.

This element would benefit from integrated validations including the NM and FOC prototypes (covered in WA 1) and the ANSP prototypes (covered in WA 3).

- **FF-ICE/R2 precursor for the revision of the agreed trajectory in strategic execution**

  This research element covers the ANSP contribution to the FF-ICE/R2 precursor for the revision of the agreed trajectory in strategic execution:

  - Coordination between the local ATFM units and NM during the CDM process to agree to the revision (if the process developed by WA 1 project so requires).
  - Once of the CDM process is completed, reception by ANSPs of the revised trajectory.
  - Delivery by ATC systems of the clearance for the revision of a 2D trajectory (if the process developed by WA 1 project so requires).
  - Monitoring of the consistency of the air and ground trajectories for ADS-C equipped aircraft, potentially with a specific process with aircraft with a flight plan that has been revised in execution (e.g. with a version number 2 or more if the flight plan version number is applied).

  This element would benefit from integrated validation covering the network aspects (covered in WA 1) and the ANSP aspects (covered in WA 3). If the clearance is delivered by ATC systems, the validation must include live trials or integrated simulations with airborne prototypes and ATC system prototypes.

- **Improved management of military flights**

  The objective of this element is to improve the handling of military missions and to reduce their impact on civilian traffic. This requires the development of ANSP local ATFM platforms to support improved CDM processes based on iOAT and later military FF-ICE flight plan, and the integration in ATC platforms of the advanced military flight plan formats. The development of ATC automation for improving the quality of service to military flights and for reducing the impact of military flights on civilian traffic is also in scope.

- **Advanced target time of arrival (TTA) coordination for out-of-area departures**

  The research element addresses the evolution of TTA management process in solution PJ.25-02 “Target Time of Arrival (TTA) management for seamless integration of out-of-area arrival flights", which aims at avoiding many long to medium-haul flights arriving at the same time and having to hold. This may include, for example:

- A concept where the departure times would now be sent to the (out-of-area) departure ASP in addition to the FOC, so that the departure ASP can support adherence to the target take-off time.
- Improvements to the algorithms use for the allocation of TTAs to long-hauls.
- An increase in the level of automation of the processes.

This element would benefit from integrated validations with WA 1.

- **Mission Trajectory with dynamic mobile areas (DMA) type 3**

The research area covers the development and validation of the application of dynamic and mobile airspace segregation, the dynamic mobile area type 3 concept element of advanced flexible use of airspace (AFUA) as integral part of mission trajectory management processes throughout the trajectory planning and execution phases.

Detailed R&I needs in support of the reduction of the climate impact of aviation:

- **Network-orchestrated avoidance of eco-sensitive areas**

While it is expected that ATM can facilitate voluntary contrail avoidance in low traffic-density situations, in medium or high traffic-density situations it is expected that a coordinated approach will be required. The objective is to develop a concept for the integration of contrail avoidance processes in existing DCB processes, but also addressing when required (e.g., long-haul flights) strategic or tactical contrail avoidance (in the execution phase, via FF-ICE/R2 if strategic or directly with ATC if tactical).

Research should determine the criteria for the declaration of an ECO-area or ECO-spot, defined as a volume of airspace that is considered to be eco-sensitive from the non-CO_2 perspective, for example because warming contrails are predicted during a period of time. The prediction can use satellite imagery, ground cameras, LIDAR (see WA 2-1, aircraft as a sensor). The operational concept must consider the uncertainty in the prediction of contrails and its impact on the achievement of the performance objectives. NM would then incorporate this information in its systems to regulate traffic through the eco-area. This could mean to completely close the airspace volume to air traffic or to simply reduce the flow of traffic. The contrail avoidance process needs to be integrated in existing DCB processes, together with other constraints considering the local / network DCB levels. The process will also consider the options for ATC/NM to respond to airline-led (AUs to be encouraged by mandates to minimise climate impact) or for ANSP-lead contrail avoidance.

Research also includes the need for improved weather forecasting/prediction and climate impact assessment.

As it is known that different types of fuel have different impacts on contrail formation, the type of fuel (e.g., particulate matter content of conventional fuels, SAF blend, etc.) of a flight might determine whether or not they are authorized to fly through the eco-area. In this case, a field with the type of fuel may need to be added to the FF-ICE flight plan. Other parameters such as aircraft type and engine type have also impact on non-CO_2 impacts, and the FF-ICE flight plan may also to be updated to include the required technical parameters. The incorporation of non-CO_2-relevant aspects in the flight plan should be done in an automated way. A process for estimating the fuel blend of each individual flight based on the re-fuel history of the tail number may need to be developed.

Flights that are not authorised to fly through an eco-area will be offered a vertical or horizontal re-route, and/or a delay if the eco-area is expected to go cold in a relatively short time. The re-route and/or delay will be sent as a reply to the filing of the FF-ICE flight plan, together with information on the parameters of the eco-area (location, time, and category (e.g., all traffic forbidden, limited traffic allowed, only specific SAF traffic allowed, etc.). Flights traversing ECO sensitive areas could be assigned a (to be developed) "eco-sensitivity index" and after evaluating trade-offs between reducing the non-CO_2 effects and potentially increasing the CO_2 effects (fuel burn and flight time) through flight rerouting, a “mitigation index” could be estimated and quantified. Flight planning software may need to be updated to incorporate non-CO_2 mitigation actions. Research should focus on acting on the highly climate warming areas or flights (individual flights that have a net CO_2 + non-CO_2) as well as in flows which will require different considerations than individual flights and which are the basis for NM. The transition from the current fuel-based criteria for green trajectory optimization to a holistic assessment that includes both CO_2 and non-CO_2 environmental impacts should be addressed.

The research element further assesses the roles and responsibilities of various stakeholders throughout the contrail process, from planning to execution, considering how local initiatives can integrate into network management assessments, when and how to integrate them. The development of ATC support tools is also in scope. Note that there is on-going work under projects CONCERTO and CICONIA (i.e., accuracy of the weather/climate prediction models (e.g., ECO area/spot prediction and management of avoidance trajectories on both AUs and ATC sides)) on this topic should be considered.

- **Automatic queue management and dynamic E-TMA for advanced optimised climb and descent operations and improved arrival and departure operations**

  Research aims at improving descent and climb profiles in busy airspace, as well as the horizontal flight efficiency of arrivals and departures, while at the same time ensuring better traffic synchronisation, short-term demand capacity balancing (DCB) and separation in TMA/E-TMA environment.

  Research may address aspects such as: automatic arrival streaming in systemised airspace, automatic and dynamic distribution of traffic across offload arrival and departure routes at periods of peak demand, leveraging ATS-B2 (via CPDLC messages) in supporting less constrained descents (e.g., by automatically providing speed constraints to aircraft descending on the same route, e.g. following the approach proposed by SESAR project OPTA-IN), AI-based what-if capabilities, automation of extended ATC planner tasks, etc.

  Research shall consider the work performed by SESAR 2020 SESAR solutions PJ.01-W2-08A1, PJ.01-W2-08B1 and PJ.01-W2-08B4 (including recommendations documented in the relevant contextual notes) and demonstrate how the limitations from the previous approach will be addressed).

  This element would benefit from air-ground integrated validation activities integrating the ground prototypes (covered in WA 3) and the airborne prototypes (covered in WA 5).

- **Dynamic allocation and uplink of arrival and departure routes considering CO_2, noise and local air quality**

  In contrast to today's one-size-fits-all approach to noise abatement departure procedures (NADP), SIDs and STARs, the future ATM system will dynamically allocate departure and arrival routes to each individual aircraft. This should initially be based on the development of a much larger catalogue of route structures (including SIDs and STARs) compared to what exists today. These route structures can be activated or deactivated depending, for example, on the time of day, for noise control purposes, or depending on traffic demand, so that the use of more complex route structures is avoided during periods of low demand, enabling agile responses to variations of operational conditions in the terminal area such as traffic density, airspace availability or environmental constraints. The dynamic use of RNP route structures will allow trade-offs and optimisation of benefits depending on traffic demand (e.g., improved capacity during peak periods, fuel-efficient operations during off-peaks, reduced noise footprint at night) in the TMA. Research will determine how the allocated routes will be passed on to the aircraft; it is expected that whenever possible this will be in the form of a clearance, but in some cases, it may be necessary to provide the new route as an "EXPECT" instruction for the aircraft to plan against, with the clearance being delivered at a later stage. Uplink of information expected delay or distance to go (DTG) is also under scope.

  Arrival Manager (AMAN) system with enhanced functionalities as needed, is expected to support the dynamic assignment of the optimal and most eco-efficient RNP route structures, depending on metrics such as predicted arrival airborne delay.

  This research element addresses the end-to-end concept, including cross-border aspects and the uplink of the delivery of the STAR clearance to each aircraft. The target concept is for the clearance to be delivered automatically via CPDLC and is loadable in the FMS with a push-to-load action from the flight crew. The research should also develop the required on-board capabilities to support the crew in his/her decision for proposed trajectory acceptance.

  The research element also addresses departure routes too, which can be delivered as part of the departure clearance. If allowable at the aerodrome, the departure route can be updated during the taxi phase because flight-deck automation will allow the use of CPDLC and push-to-load during the taxi phase. Runway management and departure route allocation will incorporate tailored noise abatement departure procedures accounting for the individual aircraft climb performance transmitted via the ADS-C EPP. Weather prediction will be used in real time to predict the circulation of emitted particulate matter around the airport and considered as an input to runway, departure, and arrival route allocation to maximise local air quality (LAQ). Note that there is on-going work on TMA route allocation by projects GALAAD and DYN-MARS.

  This research element also includes the definition of new NADP concepts and a combined SID and NADP allocation concept that will be based on the optimisation of environmental impact functions that consider potential trade-offs between local capacity, LAQ, noise impacts in the area around the airport and impact on the climate at global level. It is anticipated there will be an initial concept in which the SID scheme is established in advance depending on the MET prediction, for example 4 hours in advance, and published so that AU can consider it in their flight-plan. In the longer term, the allocation will be done on a case-by-case basis and more dynamically (up to just before the aircraft leaves the gate).

This element would benefit from air-ground integrated validation activities integrating the ground prototypes (covered in WA 3) and the airborne prototypes (covered in WA 5).

- **Advanced curved approach and departure operations in the TMA**

  Using curved flight trajectories in the approach phase of medium/high complexity TMAs based on barometric altitude optimises flight efficiency and lowers gaseous emissions and noise whilst maintaining runway throughput, thanks to a shortened lateral path and more efficient vertical path by using advanced PBN specifications (e.g., advanced RNP and RNP APCH) considering the aircraft performance and capabilities. It also provides a means to comply with increasing environmental constraints at TMAs. The scope covers spacing considerations for curved / RNP APCH and straight-in approaches. Research shall consider the work done by SESAR solution PJ.02-W2-04.1 "advanced curved approach operation in the TMA with the use of barometric altitude".

  The scope also covers the development of advanced curved departure operations, which consist of initiating the first turn as soon as departing aircraft cross the departure runway end (DER) based on GNSS navigation (increasing the flexibility in departure procedure design) and using existing airborne capabilities to greatest extent possible. This has a positive impact on gaseous emissions, noise of TMA operations and flight efficiency. Research shall consider the work done by SESAR solution PJ.02-W2-04.2 "advanced curved departure operations in the TMA".

  This element may benefit from air-ground integrated validation activities integrating the ground prototypes (covered in WA 3) and the airborne prototypes (covered in WA 5).

- **Flexible eco-efficient ATC clearances**

  When specific conditions are met, typically low traffic conditions, ATC may issue flexible clearances. The targeted flexibility may include free lateral or vertical route deviation (without the need to require a new route clearance) for flight optimisation purposes, so that aircraft can, for example, be cleared to cruise between two flight levels or be allowed the freedom to deviate horizontally within a certain area, allowing more effective use of favourable winds. This concept requires the adaptation of the ATC system. This may require support tools for the flight crew to facilitate the request. For flexible eco-efficient clearances to be issued by CPDLC, the ATS B2 standard would need to be modified to include them. In low traffic conditions, voice could be used instead as an interim concept.

  This element would benefit from air-ground integrated validation activities integrating the ground prototypes (covered in WA 3) and the airborne prototypes (covered in WA 5).

- **Dynamic separation minima**

  This research element extends the dynamic pairwise separation minima for approach and landing to en-route and TMA, based on predictive modelling and ML techniques and enabled by further automation and improved connectivity with the objective of increasing airspace capacity and hence improving flight efficiency. The objective is to develop new geometry-dependent pair-wise separation minima in en-route and TMA. It may address vertical and/or horizontal separation minima and/or a combination of both (e.g., separation must be above XX NM *and* 500 ft.). The separation minima to be developed include both minimum radar separation (MRS), which aims to keep the risk of collision sufficiently low to meet the target level of safety (TLS), and minimum wake separation (MWS), which aims to keep the risk of wake encounter sufficiently low to meet the TLS and potentially provide safety benefits. The separation to be applied in operations will always be the maximum of the applicable MRS and MWS. The operational improvement will also require combined separation minima and consideration of flight-specific data. Research must consider the safety aspects related to wake vortex. Note there is previous research in the area in project R-WAKE, and that there is a potential dependency between the reduction of vertical separation minima and geometric altimetry, covered by WA 5-3. There is ongoing research on geometric altimetry in GREEN GEAR.

- **En-route and TMA digital environmental performance dashboards**

  The aim is not only to provide visibility of environmental metrics but also to support their progressive integration into the decision-making process at strategic, pre-tactical and tactical levels, including the consideration of trade-offs with other performance indicators. The enhanced environmental performance dashboards are expected to incorporate existing metrics and expand the environmental impact assessment toolbox by developing novel metrics to provide a more complete picture of the impact of aviation on the environment than is possible today. This may address, for example:

  - Support for the inclusion of environmental criteria (noise, CO_2 and non-CO_2) for the management of runway use.
  - Development of energy-based metrics, which allow the comparison of the impact on different ATM actions using a score that is independent of the propulsion system / fuel type of each of the individual aircraft. This will become an essential metric as the evolution of the fleet mix makes the classic comparison of overall fuel burn or CO_2 emissions obsolete.
  - Enhancement of the current optimised descent operations (ODO) / optimised climb operations (OCO) monitoring to include complementary m metrics that capture the inefficiencies caused by early descent (time from top of descent (TOD) to landing, difference between actual and extended projected profile (EPP) TOD, machine learning (ML)-based metrics that provide an energy-based score of the efficiency of the descent, etc.).
  - Monitoring of the inefficiencies caused by aircraft cruising below their optimum flight level. This will require the development of a system to allow the AU to provide the desired flight level from each flight (e.g., through the unconstrained desired trajectory (UDT) or through alternative means).
  - Development of advanced horizontal efficiency metrics that factor out the extra miles (KEA - key performance environment indicator based on actual trajectory) flown when avoiding active military areas that are in use but count as inefficiency the extra miles that are flown around military areas that are not in use.

  Special attention should be paid to reinforcing coordination between TMA and airport regarding environmental performance, ensuring that environmental performance dashboards make visible trade-offs between different environmental impacts (e.g., fuel, noise in TMA, climate change), and between environmental impacts and other performance indicators (capacity). The information from the environmental dashboards that is relevant to the public and hence the research should include a study on how to best make relevant data available to all European citizens.

- **Dynamic airspace in wider context of advanced DCB and digital INAP**

  Dynamic airspace in wider context of advanced DCB and digital INAP enables a near real-time configuration of the airspace with human operators and systems teaming up to meet the needs of all airspace users (civil and military) and to manage capacity more efficiently. For certain sub-operational environments, the system will be fully automated and able to handle both nominal and non-nominal situations. The process configuration, which today is designed to minimise complexity for human operators, will become more dynamic and, where applicable, near real-time. Research may consider the integration between dynamic airspace configurations, virtual centre and increased flexibility of ATCO validations. Topics can combine ATS delegation aspects (e.g., inter/intra ANSP and inter/intra providers) including solutions such as increased flexibility of ATCO validations and virtual centre, which are expected to complete TRL6 in project IFAV3, VITACY, iSNAP and ISLAND.

- **Operational use of VHF LEO in European outermost regions**

  This element covers the development and validation of the operational use of LEO VHF voice and datalink in remote areas, where currently VHF voice and VDLM2 is insufficient. In combination with space-based ADS-B, the availability of this new CNS service will make it possible to upgrade the ATM service, allowing a reduction of separation minima and hence increased capacity and reduced environmental footprint. Note this element develops the operational use of the CNS technologies developed by ongoing SESAR project ECHOES. This element must address the relevant regulatory aspects.

- **Increased security virtual centres and aeronautical data service providers (ADSP) against cyber-threats**

  In the context of ADSP and virtual centres, which may utilise private or public clouds for hosting their systems, it becomes essential to design these systems with adaptability to cyber threats in mind.

  In anticipation of predicted cyber threats, these systems should be capable of, for example, dynamically reconfiguring their connections, and physically relocating hosting hardware in reaction to cyber-attacks.

  Consequently, the development of these systems must prioritize adaptability to cybersecurity threats through specific design requirements. Such systems should be able to perform tasks such as the following:

  - To identify active threats and threat scenarios in real-time.
  - To predict the potential means of evolution of threat scenarios in real-time.
  - To adapt in response to threat scenarios.
  - To recover to restore full operations.

2.6.3.2 Topic HORIZON-SESAR-2025-DES-IR-02-WA3-2: Enhanced CNS capabilities

Specific conditions for WA3-2	
Expected EU contribution per project	The SESAR 3 JU estimates that a maximum EU contribution of EUR 10.00 million would allow these outcomes to be achieved. Nonetheless, this does not preclude the submission or the selection of a proposal requesting a different amount.
Indicative budget	The total indicative budget for this topic is EUR 20.00 million

Expected outcomes

To significantly advance the following development actions:

- IR-3-01 Next generation ATC platform: addresses the next generation ATC platform, fully leveraging aircraft capabilities. This includes supporting a data-sharing service delivery model, **resilient integrated CNS/MET as a service**, traffic synchronisation, etc., accommodating the specific needs of the military, innovative air mobility (IAM), higher airspace operations (HAO), and U-space, etc.
- IR-3-09 **CNS capabilities to increase ATM system robustness** (e.g., satellite-based multilateration (MLAT)), GBAS dual frequency/multi constellation leveraging Galileo and providing robust protection against jamming and spoofing).

This includes advancing the capabilities of the following systems:

- CNS systems: improved navigation and surveillance systems.
- ATS systems: ability of core ATS platforms for en-route and TMA operations to leverage CNS data as a service.

Scope (R&I needs)

The following list of R&I needs is proposed as an illustration of the potential project content, but it is not meant as prescriptive. Proposals may include other research elements beyond the proposed research elements below if they are justified by their contribution to achieve the expected outcomes of the topic and are fully aligned with the development priorities defined in the European ATM Master Plan.

- **CNS as a service**

  Research shall address potential solutions for the provision of communication, navigation, and surveillance functionalities as a cloud-based or subscription-based service (CNSaaS) by an independent organisation. CNSaaS aims at offering these critical functionalities to aviation stakeholders, such as airlines, aircraft operators, and air navigation service providers, as a service model. Research results shall enable the decoupling of CNS service provision from the physical location of the infrastructure as outlined in the target architecture defined in the European ATM Master Plan.

  The scope covers the identification of possible CNS technologies and functions that could be provided as a CNS as a service and the development of relevant business models that could provide these CNS services including the assessment of technical requirements, such as spectrum management and efficiency, redundancy, flexibility of equipage of avionics and cyber security. Note that there is on-going work under project CNS-DSP. Research shall also consider the guidance material on CNS service assessment produced by PJ.14-W2-76 in SESAR 2020.

This includes the development of CNS infrastructure monitoring services.

- **New air/ground technologies for the integration of high-altitude pseudo satellites (HAPS), hypersonic and supersonic vehicles and space launches.**

  Higher airspace operations (HAO) represent one of the most profound changes to the aviation ecosystem for many years. The number of space operations, high-altitude pseudo-satellites (HAPS), supersonic and hypersonic vehicles is set to steadily increase in the years ahead. This research area aims at developing new (or adapting exiting) air / ground CNS capabilities to ensure the safe and efficient integration of hypersonic and supersonic vehicles into ATM. This may include:

  - The review / update of navigation services to meet the demands of HAPS, supersonic and hypersonic aircraft, and space launches (e.g., assessing the performance of GNSS systems supplemented with inertial systems to serve as backup during temporary GNSS outages caused by high-speed plasma formation or space radiation effects).
  - The integration of space-based ADS-B for tracking HAPS or supersonic and hypersonic aircraft at higher altitudes and speeds and its application for space surveillance and tracking (SST) for HAO. Space-based surveillance enables increased safety, through permanent real-time monitoring of air traffic worldwide, more ecofriendly ATM operations, and stronger resilience to GNSS degradations. It can also contribute to global rationalisation of terrestrial and space surveillance infrastructures through the integration of new space technologies (e.g., small and nano satellites, LEO, etc.).
  - The development of non-cooperative surveillance technologies for HAO, based e.g. on technologies in use for space situational awareness (SSA) and space surveillance and tracking (SST), or technologies in use for military surveillance of the airspace.
  - Provision of space weather services including emerging requirements for atmospheric observations and forecasts for supporting HAO.

  These technologies are civil/military dual use.

- **Satellite based multilateration (MLAT)**

  Nowadays, surveillance tracking systems rely on self-reported positions of aircraft, which are derived from GNSS satellites, which can be affected by interferences caused by different causes (e.g., spoofing, jamming, etc.).

  This research element covers the development of a complementary, resilient, space-based surveillance infrastructure, which uses a low earth orbit (LEO) satellite constellation to track aircraft by determining their exact position based on multilateration (MLAT) (i.e., using different times of arrivals of radio frequency (RF) signals). By independently verifying the location of an aircraft through geolocation satellite based MLAT technology, the proposed solution shall be able to track a plane in real time from take-off to landing.

Research shall address the end-to-end validation of the proposed solution including both satellite (space segment and space network) and ground ATM components and determine and validate both functional and non-functional (i.e., performance) requirements. It is acknowledged that performing an end-to-end TRL6 validation with LEO constellation may be challenging; therefore, the proposals shall consider, as a preliminary step, the maturity of the different segments (space segment, space network, ground segment) separately, and clearly identify the risks to achieve TRL6. Also, research shall cover the description of future operations and service definition.

- **Use of ADS-B phase overlay**

  The objective is to develop applications that take advantage of the ADS-B phase overlay, for example:

  - Secure ADS-B: Currently, there are no means to know if a single ADS-B message is valid or not, or if the sender is real or fake. For verification, surveillance systems correlate several messages and sources, what requires efforts and infrastructure. Research shall aim at completing the R&I work on this use case, to increase the security of ADS-B introducing authentication through the data capacity provided by phase overlay. The research should investigate how secure ADS-B might allow the rationalization of the surveillance infrastructure, especially Mode S. Note that there is on-going work on this use case (to "anonymize" the ADS-B messages) under project MITRANO.

  - Applications of ADS-B phase overlay that allow a reduction in the congestion of the 1030/1090 MHz frequency, which can lead to situations where the system performance does not comply with the safety required for specific separation applications, what leads to restrictions to access the airspace, potentially inducing delays and flight cancellation.

  Note ADS-B phase overlay should be developed as a civil/military dual-use technology.

- **Collaborative cyber security framework for CNS**

  Current aeronautical cyber security standards, recommended methodologies, and state of the art, responses to cybersecurity-threats and processes are based on some key assumptions:

  - Aircraft is managing its own security and certification is managed at aircraft level only.

  - Security solutions often rely on a binary trusted/untrusted security model.

  - Security working groups and technical standards covering different aspects of the whole architecture work as silos.

  Those assumptions may not be sufficient to provide effective and long-term defence against cyber security attacks to automated aeronautical CNS environment.

  Research shall aim at defining and validating a global security collaboration framework based on uses cases across CNS domains, considering the end-to-end chain to address cybersecurity at global level. Research shall consider the network level cybersecurity when network is not aviation specific: what kind of cybersecurity requirements need to be put in the service provider, including addressing common points of failure.

Research shall address potential solutions to mitigate radio frequency interference based on different techniques (e.g., filtering out jamming signals, etc.) or evaluating solutions employed in non-aviation applications, dynamic jamming/spoofing information sharing and the potential application of AI in this field. Research shall focus on developing aircraft-installed active radio antennas capable of adapting itself to the attack and mitigating the impact of radio jamming attacks. Military requirements shall be addressed. This research element also covers the monitoring and mitigation of the potential cybersecurity risks that may be introduced with the new entrants (e.g., HAO).

Note that there is on-going work on this research element under project FCDI solution 0338 "Collaborative Cyber Security Framework for CNS".

- **Combined airborne and ground dual-frequency multi-constellation (DFMC) ground-based augmentation system (GBAS) GAST-E approach service**

  Develop DFMC GBAS (GBAS GAST-E) to maximise the benefits of this technology, including for CAT II/III operations, to allow for more robust operations, including at high and low latitudes with tougher ionospheric conditions. This element also addresses increased resilience to radio frequency interference on a single band and increased resilience to single-constellation outages or failures. This includes the following elements.

  - Develop both the DFMC GBAS ground station and the DFMC GBAS airborne receiver to TRL6 for GAST-E and carry out ground–airborne interoperability testing and performance validation. Note that the DFMC GBAS airborne receiver is not yet at maturity level TRL4, and therefore an essential priority would be developing and maturing it as quickly as possible to catch up with the development of the DFMC GBAS ground station, which completed TRL4 in SESAR 2020 under SESAR solution PJ.14-W2-79b "DFMC GBAS - GAST F".[86]. The proposal should address both ground and airborne aspects and include Galileo and EGNOS V3.

  - Ensure that the DFMC GBAS baseline development standards and recommended practices (BDS SARPs) adequately covers definition of the interface for downwards compatibility (GAST-D, GAST-C).

  - Develop a prediction service to anticipate CAT II/III unavailability due to atmospheric/solar events (forecasting ionospheric conditions and gradients) and to provide an estimate of expected performance in terms of minutes of expected unavailability of the service per year, including potential correlation with low-visibility procedures (if there is any). An alert service that forewarns airspace users in a timely manner of expected outages, prior to the outage happening, is necessary for the safe and efficient conduct of flights.

  - Potential use of precise military GNSS signals (e.g., GPS pulse per second (PPS), GALILEO public regulated service (PRS), deemed equivalent to civil signals (e.g., GPS

[86] Note that this is an architecture change agreed at ICAO from GAST-F to GAST-E, which may require revalidation of part of the TRL4 material for GAST-F).

standard positioning service (SPS)), to support military compliance to civil NAV requirements and/or other uses.

- Support standardisation and accelerated certification activities, including:
  - The creation of a new ICAO standard for GAST-E in line with the DFMC GBAS concept and the extension of current GAST-D standards to augment Galileo / EGNOS V3 signals.
  - The provision of standards that would allow the industrialisation of GBAS equipment (ground station and airborne receiver) to ensure the timely delivery and full compatibility of both subsystems.
  - Produce minimum operational performance standards for ground and airborne equipment, based on the work of EUROCAE Working Group 28 (in coordination with the Radio Technical Commission for Aeronautics (RTCA) Special Committee 159).
- Develop implementation guidelines, considering different airport layouts / levels of complexity.

- **Ground-based Alternative – Position, Navigation and Timing (A-PNT)**

Global navigation satellite systems (GNSS) including Galileo and the European geostationary navigation overlay service (EGNOS), are usually considered as suitable technologies for providing position, navigation, and timing (PNT) information as required. However, GNSS can be subject to local (e.g., interference, spoofing, jamming) or global (ionospheric issues, system fault) outages, and it also presents service limitations in those areas where there is limited sky visibility.

With the objective of having a back-up solution for GNSS as the source of PNT in the situations above, several potential technological solutions have been or are being developed to provide alternate position navigation and timing (A-PNT). The proposed solution aims therefore at enhancing service resilience (e.g., to RFI), availability, and continuity. This requires the support of industry standards to ensure the required interoperability. The proposed solutions should investigate how their developments fit into the larger cross-domain European complementary PNT (C-PNT) framework. The notion of C-PNT aims at building a larger European PNT ecosystem to mitigate the risk of PNT service interruption, which includes GNSS and several complementary emerging alternative systems.

Research shall address the different options for time synchronisation (in particular during GNSS outages). On this point, there is on-going work performed by MIAR SESAR solution 0336 “LDACS-NAV solution & Modular Integration of A-PNT technologies solution”.

This research element covers A-PNT that has both an aircraft and a ground component, including, but not restricted to:

- Enhanced DME for TMA: Aircraft navigate primarily using satellite-based signals, supported by ground-based infrastructure where needed. A prolonged outage of GNSS constellations has the potential to limit the ability of aircraft to take advantage of precise PBN procedures, impacting flight efficiency and airspace capacity.

Research aims at developing alternative position, navigation, and timing (A-PNT) as a technical enabler to support PBN/RNP operations in case of extended GNSS degradation or outage. Research shall develop an enhanced distance measuring equipment (eDME) with capability to support more stringent A-PNT requirements. The technology is based on a coupling of the on-board interrogator and ground-based transponder equipment to provide a smooth and seamless implementation path and improved frequency band usage. The eDME equipment is expected to support more stringent RNP and improve spectrum efficiency, for example reducing L-band congestion. It anticipates minimum change to the on-board and ground hardware.

The proposed solution shall introduce, in addition to the actual range capability (interrogation-reply), a pseudo-ranging (one way ranging), and ensure that the additional capability is fully backward compatible to support seamless deployment.

- Mode N A-PNT: Mode N is a ground-based system based on secondary surveillance radar signal formats that provides an A-PNT capability to backup global navigation satellite systems while retaining legacy distance-measuring equipment (DME) functionality. Mode N aims at delivering maximum spectrum efficiency combined with backward compatibility with legacy systems. Compatibility with military systems needs to be guaranteed. Since Mode N provides the opportunity to release a significant part of the L-Band frequencies currently occupied by DME and TACAN. The interoperability of Mode N is ensured by utilizing L-Band frequencies which are currently not used by DME on a global basis (although are used by military systems and spectrum compatibility needs to be guaranteed).
- A-PNT for vertical navigation to address use cases applicable if moving to a geometric height environment.
- Study reliance on TACAN as a means of A-PNT to support military compliance to NAV requirements.

Other technologies may be under scope, provided that they meet accuracy, availability, continuity, and integrity requirements.

2.6.4 Work Area 4: Future airport platform

This working area targets the evolution of airside operations, including aircraft turnaround, taxi, and take-off and landing clearances, into a highly automated environment. The aim is to develop a future platform incorporating advanced technologies and a service-oriented, cloud-based model. This model allows dynamic capacity adjustment to meet the demands of all airspace users while improving safety and environmental sustainability. Key areas of focus include enhancing cyber-resilience, leveraging artificial intelligence, and fostering civil-military collaboration for airport operations management.

Specific conditions for WA4	
Indicative budget	The total indicative budget for this work area is EUR 30.00 million
Type of actions	Research and innovation action (RIA)
Other requirements	The maximum project duration is 36 months.

2.6.4.1 *Topic HORIZON-SESAR-2025-DES-IR-02-WA4-1: Next generation ATS platform for airport operations*

Specific conditions for WA4-1	
Expected EU contribution per project	The SESAR 3 JU estimates that a maximum EU contribution of EUR 12.00 million would allow these outcomes to be achieved. Nonetheless, this does not preclude the submission or the selection of a proposal requesting a different amount.
Indicative budget	The total indicative budget for this topic is EUR 24.00 million

Expected outcomes

To significantly advance the following development actions:

- IR-4-01 **Next generation airport platform** addresses the next generation airport platform fully leveraging aircraft capabilities. This includes supporting the data-sharing service delivery model, interconnected with other airports and their 3rd parties (e.g. ground handlers), ANSPs, NM, CNS/MET as a service, etc., facilitating the accommodation of IAM, the interface with U-space as well as specific needs from the military.
- IR-4-02 **Artificial intelligence** (AI) capabilities enabling the next generation of airport platforms.
- IR-4-03 **Cyber-resilience and cyber-security capabilities** enabling the next generation of airport platforms.
- IR-4-04 **Airport solutions for reducing environmental impact operations**. This includes sustainable taxi related concepts, environmental performance dashboards, etc.
- IR-4-05 Future **human – machine teaming**.
- IR-4-06 Optimisation of **runway throughput**.
- IR-1-01 **Integrated air/ground trajectory management** based on ATS-B2 including the extension for lower airspace and airport surface.

This includes advancing the capabilities of the following systems:

- Ground systems: core ATS platform for airport operations.

Scope (R&I needs)

Research aims at developing the next generation of airport platforms, considering state-of-the-art ground technologies while leveraging innovative solutions and new aircraft capabilities aiming to achieve level 4 of automation as outlined in the Master Plan and by considering a trustworthy AI approach. The targeted airport platforms shall enable the following capabilities:

- Ensuring that all flights/missions (crewed or uncrewed) operate in the airport and in adjacent airspace in a way that maximises, to the fullest extent, aircraft capabilities to reduce the overall climate impact of aviation (CO_2 and non-CO_2) (see detailed R&I needs below).

- Ensuring that each flight trajectory is optimised considering the individual performance characteristics of each aircraft, user preferences, real-time traffic, local circumstances, and meteorological conditions at the airport. This optimisation shall be systematic, continuous (from planning to execution), and extremely precise throughput is improved in high demand scenarios (see detailed R&I needs below).

- Intelligent surface management and airport safety nets maintain airport operations safe in all weather conditions while runway throughput is improved in high demand scenarios (see detailed R&I needs below).

- Service providers can dynamically and collaboratively scale capacity up or down in line with demand by all airspace users. These capacity adjustments are implemented in real time and ensure optimal and efficient dual (both civil and military) use of resources at any moment at the airport (data, infrastructure, and human-machine teaming).

- Endpoints, data connection and ecosystem are cybersecure thanks to enhancement to key properties of information security such as, but not limited to, strong identification, authentication and integrity. Post-quantum cryptography (PQC) algorithms.[87] should be considered where appropriate, ensuring cyber-resilience risks are adequately managed. Collaboration among airports and system manufacturers will enable an enhanced cybersecurity in the next generation of ATS platforms. Research shall consider the on-going work by ICAO on the international aviation trust framework (IATF), which aims at developing standards and harmonised procedures for a digitally seamless sky and dependable information exchange between all parties.

- The contribution during airport operations to the continuous optimisation of every flight/mission from gate to gate is systematically guaranteed thanks to high connectivity between air-ground and ground-ground components.

- The human operator is performing only the tasks that are too complex for automation to manage, teaming up with automation (see automation roadmap of the Master Plan).

- Air-ground voice communication is no longer the primary way of communicating and most routine tasks should be managed through machine-to-machine applications.

- To enable TBO phase 3 in a highly automated airport environment in accordance with the TBO and automation roadmaps in the ATM MP (see detailed R&I needs below).

Specific minimum requirements for this topic:

Consortia for this topic shall include:

- At least three airports.

- Either include an established ATS airport system manufacturer or provide evidence that the consortium has the operational and technical capability to build the ATS airport system prototypes required for the research at the required maturity level.

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[87] https://digital-strategy.ec.europa.eu/en/library/recommendation-coordinated-implementation-roadmap-transition-post-quantum-cryptography.

The proposed target architecture shall be aligned with the service delivery model outlined in the Master Plan.

Detailed R&I needs to enable TBO Phase 3 to be considered:

The following list of detailed R&I needs is proposed as an illustration of the potential project content, but it is not meant as prescriptive.

Proposals may include other research elements beyond the proposed research elements below if they are justified by their contribution to achieve the expected outcomes of the topic and are fully aligned with the development priorities defined in the European ATM Master Plan.

- **ADS-C standard instrument departure (SID) conformance monitoring on the airport surface**

  This element covers the conformance check that the correct SID is loaded on the FMS based on the ADS-C downlink. This is a safety net that functions automatically in the background. The aim is to preserve safety in a more flexible environment where environmental constraints may result in SID allocation becoming less predictable than in the past.

- **Use of ATS B2 CPDLC v2/v4 on the airport surface**

  This solution covers the development of the ATC ground systems, in support of the use of CPDLC on the airport surface. This includes an enhancement of the D-TAXI capabilities to allow the use of CPDLC to uplink taxi clearances when the aircraft is already taxiing, as well as for the uplink of a revised departure route at any point after the aircraft has left the gate until shortly before take-off. The request for the uplink of a revised SID will typically be sent from the TMA systems to the TWR systems. The new departure route could be a SID (i.e., one of the published departure routes from the airport) or a custom-made departure route (e.g., a published SID but with vertical constraints aimed at facilitating a better climb profile). This increased flexibility will make it possible to uplink departure routes shortly before take-off with vertical constraints to ensure separation with other aircraft so that aircraft fly more efficient vertical profiles. This applies in particular to the tactical uplink shortly before take-off of departure routes that ensure separation between departures and/or arrivals to/from the same or proximate airports based on actual traffic rather than SIDs being loaded at the gate assuming a worse-case scenario.

  This element would benefit from air-ground integrated validation activities integrating the ground prototypes (covered in WA 4) and the airborne prototypes (covered in WA 5).

- **Enhanced optimised and safe runway delivery for arrivals and departures**

  Enhanced optimised separation delivery for arrivals and departures using more accurate flight-specific predictions of final speed profiles derived from either an evolved extended flight plan or an EPP downlinked from the aircraft using ADS-C or advanced big data / ML techniques. Research may include automatic real time wake turbulence separation on departure based on LIDAR and its integration on ATS platform. This requires the development of SWIM based meteorological services as automatic input to separation and runway delivery tools employed to manage arrivals and departures at capacity constrained airports. The research element covers the possibility to operate time-based separation, which provides valuable extra landing capacity and resilience, with RNP-defined approaches. Research may consider the application of digitised augmentation to expedite decision making. Research shall consider the work performed by project PJ.02-W2 in SESAR 2020 (e.g., SESAR solutions

PJ.02-W2-14.8, PJ.02-W2-14.14, PJ.02-W2-14.7, PJ.02-W2-14.9a, PJ.02-W2-14.10, PJ.02-W2-14.11, PJ.02-W2-14.6a, PJ.02-W2-14.6b, MIAR solution 0336). This research element also covers the development of enhanced ground based surveillance sensors or sensor fusion architectures able to detect obstacles on or near the runway or predict potential runway incursions, including ATC aids for comparing traffic movement with automated recognition of ATC voice and future datalink-based clearances (work is on-going in project ASTONISH).

- **Advanced calibration of airport capacity**

  The ATFM declared capacity of an airport is the maximum number of aircraft that can be allocated a pre-departure time of arrival (TTA) in a given time slot. It considers the runway throughput and the uncertainty of traffic demand data: the higher the uncertainty, the higher the buffer in the declared capacity needs to be to ensure that there will be no holes in the sequence due to under-delivery. Uncertainty of traffic demand data not only affects to the declared airport capacity, but also to the staffing. An accurate hourly traffic demand is essential to predict how many ATC positions are needed to be opened at the tower every hour, and therefore, the necessary staff. Research aims at developing a solution aimed at leveraging the reduced traffic uncertainty brought by SESAR developments by reducing the declared capacity buffer without effectively reducing real capacity or traffic movements. Thanks to the reduced buffer, aircraft will have lower arrival sequencing and metering (ASMA) delay, which will result in environmental benefits.

- **Integrated management of single-engine and engine-off taxiing operations**

  In engine-off or single engine operations, one or more of the main aircraft engines are started in the taxi-out phase instead of at the gate. Doing so at the right time, neither too early (missing some engine-off taxi time benefits) nor too late (creating extra taxi-out time and potentially disrupting the departure sequence), is essential to maximise the environmental benefits, but this can be challenging at medium and large A-CDM airport environments at peak demand times.

  The research should address:

  - Management of single engine taxiing operations, autonomous and non-autonomous engine-off taxiing operations. This includes the direct management of tugs or the coordination with the tug manager service for airports where this service is available.
  - Mixed operations aspects: engine-off taxiing vs. conventional taxiing, different engine-off taxiing techniques in the same operating environment.
  - The synchronisation of the engine start-up and target take-off time (TTOT).
  - Scalability aspects depending on the different airport categories where the solution(s) could be implemented.
  - Impacts on other airport systems (e.g. airport operations centre (APOC), advanced surface movement guidance and control system (A-SMGCS), etc.).

  Research shall consider the output of project AEON.

- **Management of non-autonomous engine-off taxiing operations by tug fleet manager**

Research aims at developing the concept of tug fleet manager in the context of non-autonomous engine-off taxiing operations. The tug fleet manager is a new role between airport management and air traffic control who oversees the implementation of the tug's allocation plan during the non-autonomous engine-off taxiing operations. The tug fleet manager assigns their missions to tugs drivers in real time and adapts the tugs planning to any operational events (e.g., delays, failures, etc.).

The tug fleet manager will help managing the additional traffic on taxiways caused by the tugs and optimising the tugs usage. Hence it will provide following benefits: fuel and noxious emissions reduction, ground ATC workload for tow tugs management reduction and more precise sequencing with taxi times depending on actual taxiing technique and real time update. Research shall take into consideration the results of project AEON. Note that there is on-going work by project ASTAIR.

- **Data exchange between TWR and En-Route and TMA platforms**

  The existing differences in handling the essential flight plan (FPL) information between TWR and En-Route and TMA platforms result in a number of workarounds used by the ANSP or vendors to close the gap on TWR - APP/ACC systems connectivity, resulting in subsequent problems with provision of the departure sequence or other coordination elements. Going further, since the TWR systems will have to facilitate the IAM elements, research aims at evaluating and determining which information and how should be exchanged between TWR and APP systems, enabling seamless coordination.

2.6.4.2 Topic HORIZON-SESAR-2025-DES-IR-02-WA4-2: Smart airports, airports as multimodal nodes and passenger experience

Specific conditions for WA4-2	
Expected EU contribution per project	The SESAR 3 JU estimates that a maximum EU contribution of EUR 3.00 million would allow these outcomes to be achieved. Nonetheless, this does not preclude the submission or the selection of a proposal requesting a different amount.
Indicative budget	The total indicative budget for this topic is EUR 6.00 million

Expected outcomes

To significantly advance the following development actions:

- IR-4-07 **Smart airports**, airports as **multimodal** nodes and **passenger experience**.
- IR-4-03 **Cyber-resilience and cyber-security capabilities** enabling the next generation of airport platforms.

Scope (R&I needs)

The following list of R&I needs is proposed as an illustration of the potential project content, but it is not meant as prescriptive. Proposals may include other research elements beyond the proposed research elements below if they are justified by their contribution to achieve the expected outcomes of the topic and are fully aligned with the development priorities defined in the European ATM Master Plan.

- **Collaborative management at regional airports supported by Centralised Lite airport operations centre (APOC)**

  The Airport operations centre (APOC) concept was originally developed for large airports during previous SESAR phases, based on a platform/operational structure which collaboratively and pro-actively manages airport operations performance.

  Although regional airports do not generally experience operational constraints in such scale as those occurring at large ones, they do experience issues which underperform their operations. The lack of communication and information shared amongst the stakeholders causes unforeseen deterioration of the airport performance with potential knock-on effect onto the ATM network.

  The research area aims at developing a Centralised Lite APOC, aiming at the improvement of inbound, turnaround and outbound predictability based on enhanced local collaborative environment and connectivity with ATM network. The approach is simple, cost-efficient, algorithm-oriented and focusses on use of NM digital services provided to airports. Airport and network information is exchanged thereby forming the basis for improved situational awareness whilst supporting pre-tactical and tactical decision-making. Research shall consider the work performed under solution PJ.04-W2-28.2 “Collaborative management at regional airports supported by Centralised Lite APOC”. Note that there is on-going work by projects RACINE and PEACOCK.

- **AOP and performance monitoring for a group of airports**

  This research element addresses the development of a single AOP to address the needs of a group of airports with similar operational needs that are too small to have their own AOP. This AOP combines information from each individual airports to meet collaboratively agreed joint targets for the group of airports, but taking into consideration individual airport needs and situation. The coordination among airports should always align and never compete with the overall airport-network view. Research also addresses the collaborative process for the definition of performance targets agreed for any set of airports that decide to gather under such a common AOP. The wider neighbouring community will participate in this process. The benefit of joint target setting will be the ability to set more challenging targets for a group of airports than would be possible for a single airport, thus providing improved service to the airspace users over a range of KPA. The overall performance of the group of airports will be monitored against the shared performance targets. The performance of one single airport or the group of airports will be provided, suitably filtered to all the stakeholders (wide access to airport performance). When a group of airports (too small to have their own AOP) with similar operational needs have decided to gather under a single AOP, there is a need to set and monitor the performance targets to further enable performance optimisation.

- **Airport integration into the user-driven prioritisation process (UDPP)**

  The research element covers the integration of UDPP with airport driven local DCB process to support airports, airspace users, NM and ANSPs to anticipate, understand and manage arrivals related disruptive events at airports’ level in planning phase, aiming at reducing impact and knock-on effects. The potential benefits include a better management of disruptions speeding up of the recovery to normal operations. Research may include the allocation of target times for arrival flights (TTA) combined with the user driven prioritization process (UDPP) into the overall reconciliation process, also in case of multiple constraints.

The reconciliation of the arrival constraints resolution between the network management function and the airport/AUs is addressed through the following:

- Detection, analysis and coordination of the local demand/capacity imbalances during the pre-flight phase: APOC and AUs coordinate a resolution process supported by integrated tools.
- NM Network impact assessment and application of local DCB (APOC) management proposals during the pre-flight phase (pre-tactical and tactical from ATFM perspective). The progressive integration of AOP and NOP between NM and Airport, will be used when available in NM data.
- Integrating actively to the current mechanism of providing target times of arrival (TTAs) by ATM/Airport stakeholders, the AUs flights constraint through UDPP flights prioritisations.

Research shall consider the work performed by SESAR 2020 SESAR solutions PJ.07-02 and PJ.07-W2-39. Note that on-going work on the evolution of evolution of UDPP concept is performed by HARMONIC project (i.e., on regional constraint reconciliation and network constraint reconciliation).

- **Airport environmental performance management**

Management of airport operations often necessitates a trade-off between different performance criteria (e.g., flight delay, environmental sustainability, resource availability, etc.). Research is focused on airport environmental performance management with the aim of integrating environmental considerations into the overall airport operations management process, bringing the question of environmental performance into the decision-making process.

Research includes the development of airport performance dashboard / cockpit to ensure an appropriate airport environmental performance monitoring. The introduction of an environmental dashboard in the airport operations plan (AOP) supports monitoring the airport environmental performance from the mid-term/short-term planning phase (D-1) thus improving collaborative decision-making process in the APOC. This dashboard should consider a series of environmental indicators in the daily operation of an airport in the execution phase, triggering and influencing operational decisions. The environmental indicators comprise those used in the performance plans but could also include additional local indicators if needed. The monitoring of the airport environmental performance can trigger the implementation of potential solutions to reduce the airport impact on noise and emissions at and near the airport. Research shall consider the work performed by SESAR solution PJ.04-W2-29.3 “environmental performance management”.

- **Smart airports**

Smart airports, with landside and groundside fully integrated into the ATM network, will be based around connectivity and other technologies to improve operations and the passenger experience. Research objectives include:

- The integration of airport and network planning and the timely exchange of surface transport network, airport and ATM network information will bring common situational awareness and improved mobility planning activities, notably arrival and departure predictability for both airports and the network. Research may also address the integration of vertiports into airport operations and surface transport network.

- Information-sharing and collaborative decision making will allow the inclusion of outputs from landside processes (passenger and baggage) to be used to improve the accuracy and predictability of airside operations.
- Business intelligence and machine learning will help airport stakeholders collaborate to align process and resource capacity with predicted demand in both planning phase (allocation of resources) and execution phase (dynamic adjustment of the plan based on anticipated impact on punctuality of flights and passenger experience).
- As future solutions will be virtualized and distributed, smart airports should leverage the collaboration power also to enhance the cybersecurity posture to prevent, protect and increase the cyber-resilience from attacks to the infrastructure.
- Adoption of novel passenger processing solutions able to offer a seamless passenger experience within and among airports.
- Considering ATM to be an integrated part of an intermodal transport system, research may include the development of potential solutions to share data between transport modes (e.g., ATM – rail) and to better collaborate to optimise the performance of both the overall transport system and the door-to-door journey. This includes the development of an integrated transport network performance cockpit and the definition of an integrated transport network crisis management process. Note that there is on-going work under project Travel-Wise on these topics.

Drivers for this are the digital evolution of integrated surface movement, multimodal airport collaborative decision-making and flow optimisation, next-generation arrival manager in a TBO context, and enhanced integration between airspace users' trajectory management processes and ATM Network Manager processes.

- **Integration of IFR RPAS in airport and CTR operations**

Research addresses the development of solutions for a safe and efficient integration of remotely piloted aircraft systems (RPAS) in controlled airspace into the existing air traffic control (ATC) procedures and infrastructures within airports under instrument flight rules (IFR), which are dominated by crewed aviation. To the maximum extent possible, RPAS will have to comply with the existing rules and regulations. The solution includes the identification of specific requirements of remotely piloted operations compared to the crewed operations, and the development (if needed) of technological enablers that could be required for their integration in the airport environment. The scope covers the following aspects:

- Surface operations by IFR RPAS at different type of airports including required coordination for IFR RPAS by using dedicated airport scenarios. Research covers the assessment of the impact on airport capacity and on the efficiency of airport operations.
- Integration into the tower ATC systems of additional IFR RPAS information, such as latency details on voice and C2 link, and usage of a voice communication back-up line.

- Detail handover processes between several ground station operators, potentially in a real flight trial using an IFR RPAS demonstrator and investigate handover contingency procedures (e.g., lost C2 link, or pending ATC instructions). It also includes higher automation in C2 link failure conditions in the airport environment.
- Investigate context-sensitive display of contingency procedures and the reception by tower ATC and RPAS pilots at the respective working positions. The research element includes the consideration of crewed aircraft pilots in the validation of contingency procedures for awareness purposes.
- Develop requirements and architectures for direct communication between ATC and the remote pilot, avoiding relaying voice and data through the RPAS vehicle, while maintaining shared situational awareness with other airport users.
- Integration of IFR RPAS in airspace class D and E controlled from an integrated TMA/CTR -TWR ATSU.
- The use of sustainable taxi technologies in the taxi phase and/or the development of on-board and remote pilot station technologies to allow autonomous taxi.

The research shall consider the results obtained in solution PJ.03a-09 “surface operations by RPAS” and project INVIRCAT. Note there is ongoing work for the accommodation of IFR RPAS in airspace D and E in project IRINA.

2.6.5 Work Area 5: Autonomy and digital assistants for the flight deck

This working area focuses on increasing airborne automation and autonomy and the collaboration between air and ground for the integration of all airspace users. From the development of onboard capabilities and advanced digital technologies (e.g. digital assistance to the flight crew) for supporting flight crew during complex scenarios, reducing workload while improving safety and efficiency. Research on autonomy pave the ground for an increased automation of flight operations, regardless the minimum crew required, which contributes to a safety and efficiency enhancement by discharging the flight crew from routine tasks and improving the overall robustness against human error. The transition to single pilot operations (SiPO) is being explored, balancing societal expectations for human cockpit presence with increased automation for automatic flight phases.

Specific conditions for WA5	
Expected EU contribution per project	The SESAR 3 JU estimates that a maximum EU contribution of EUR 6.00 million would allow these outcomes to be achieved. Nonetheless, this does not preclude the submission or the selection of a proposal requesting a different amount.
Indicative budget	The total indicative budget for this work area is EUR 30.00 million
Type of actions	Research and innovation action (RIA)
Procedure	The procedure is described in General Annex F to the Horizon Europe work programme for 2023–2025. The following exception applies: to ensure a balanced portfolio, grants will be awarded to applications not only in order of ranking but at least also to those that are the highest ranked within topics within the same work area, provided that the application attains the threshold.

Other requirements	The maximum project duration is 36 months.

2.6.5.1 Topic HORIZON-SESAR-2025-DES-IR-02-WA5-1: Increased automation assistance for the pilot for ATM tasks

Expected outcomes

To significantly advance the following development actions:

- IR-5-01 **Single pilot operations** (SiPO). This includes new sensors and aircraft architectures for the evolution towards SiPO/highly automated operations.
- IR-5-02 **Increased automation assistance for the pilot** for ATM tasks. This includes improved flight-deck HMI and procedures for CPDLC, voice-less technology, etc.

Scope (R&I needs)

The following list of R&I needs is proposed as an illustration of the potential project content, but it is not meant as prescriptive. Proposals may include other research elements beyond the proposed research elements below if they are justified by their contribution to achieve the expected outcomes of the topic and are fully aligned with the development priorities defined in the European ATM Master Plan.

- **Single pilot operations (SiPO)**

  In single pilot operations (SiPO) there will only be one pilot onboard at any given time during flight, also during critical phases of flight such as take-off and landing.

  Research shall address the impacts on air/ground procedures to be followed by the different actors (air traffic ATCOs, pilots, and ground operators of the airline flight operations centres) needed to manage the normal, abnormal, and emergency situations of SiPO that are related to ATM, with the needed safety and the acceptable efficiency in all phases of flight.

  Research shall also address the development of the required airborne avionics for supporting SiPO that are related to ATM tasks (e.g., flight management system, surveillance function, autonomous navigation system for all phases of flight, etc.). These systems will require advanced automation and assistance in the flight deck with the objective of discharging the pilot from routine tasks in ATM, including navigation, allowing them to focus on the most critical tasks (i.e., safety of operations).

  The research should aim at minimising the impacts on ATC operators, on their tools (ATC ground systems) and on the ATC-cockpit communications means.

  Current error management very much relies on crosschecks between the two crew members, e.g., input of ATC altitude request to autopilot system. For a safe implementation of SiPO it will be essential to address the mitigation of the risk posed by increased errors in operations related to ATM and navigation due to missing crosschecks. Research should also consider the mitigation of the risk of a delay in the implementation of ATC instructions, e.g. due to it coinciding with a moment of high cockpit workload and/or a physiological break of the single pilot. The management from the ATM perspective of the pilot incapacitation emergency situation is also in scope.

If AI-based tools are applied, research should not only address workload and decision-making but also the adherence to procedures including crosschecks between the pilot and AI.

Research may consider mainline aircraft and/or commuter aircraft and/or business aircraft. For example, the following operational use cases may be addressed, potentially with different target maturity levels:

- Operation on the ground at complex airports.
- Operation on the ground at secondary airports.
- Low visibility operations with CAT II and/or CATIII.
- Operations at complex TMAs with destination/origin the main airport or a secondary airport.

Note that there is on-going work on this research element under projects SOLO, DARWIN and RESPONSE.

- **Artificial intelligence (AI) to enhance flight crew capabilities**

  Research aims at investigating how AI can support pilots in complex and critical situations, when workload may be high and/or the time to react very limited and thus improve safety. The pilot can cooperate and collaborate with the automation on board allowing efficient teaming with the automation.

  For these situations, research should focus, for example, on how to exploit high levels of automation to perform non-critical ATM tasks for pilots and how the HMI should work during such operations, so the pilot can focus on essential tasks (e.g., during taxi-out, descend, approach and landing). The tasks needed to successfully execute the mission can be dynamically allocated between human pilot and automation onboard. In addition, AI-powered applications could support the pilots in situations where workload is low e.g., engaging pilot's attention and alert the pilot in case something unexpected happens. The scope includes all pilot tasks related to ATM, including navigation and taxi on the airport surface. An area of particular focus is the management of high pilot workload situations during the descent, approach, and landing; the objective is to free pilot resources to allow the use of CPDLC with push-to-load in the TMA. Research may address the development of algorithms (that are certifiable) based on reinforcement learning to help the pilot make decisions (e.g., decisions considering the impact of system failures on performance, weather, wind at alternate, range, etc.).

  The research results should demonstrate how the technology could support pilots in carrying out their tasks (e.g., demonstrate an increase in human capabilities during the execution of complex scenarios or a reduction in human workload in the execution of standard tasks), and assess the impact on the role of the human. The research shall also address the methods and approaches that will lead to safe human-AI teaming that will lead to certifiability of the future applications.

  These applications may play a significant role in the transition to single pilot operations; proposals in this area must demonstrate the relevance of their proposed work for ATM. Note that there is on-going work related to this research element under projects JARVIS and DARWIN.

- **Advanced on-board systems and procedures in support of highly automated ATM operations**

  Research aims at developing on-board avionics and procedures, including flight crew digital assistants for fixed-wing aircraft and helicopters, in support of highly automated ATM applications. Higher level of automation defined in the ATM master plan is enabled by teaming of human pilot with digital assistants and providing human oversight to the flight. The scope includes research elements such as:

  - Improved on-board interface for ATM communications (voice, to reduce flight crew workload in the management of complex CPDLC clearances, and flight crew support to monitor their correct execution.
  - Use of CPDLC in the lower levels, including tactical uplink of 2D route revision, vertical clearances, clearance for approach, clearance to land, clearance for take-off, etc.
  - On-board systems for automatic route negotiation between aircraft systems and ATM.
  - Development of airborne digital assistants for the flight crew in support of ATM tasks to reduce flight crew workload and ensure safety levels are maintained when operating in a more complex environment. The research may include : support for FF-ICE/R2 negotiations, support for taxi operations in large airports with complex lay-outs (including CPDLC taxi clearances and support for their on-board implementation), support for sustainable taxi operations (single engine taxi or with sustainable taxi vehicles), support for wake-energy retrieval operations, support for wake vortex encounter avoidance, support for taxi in low-visibility conditions (addressing in particular expeditious vacation of the runway), etc.
  - Development of ATS B2 Revision B.

  Proposals in this area must demonstrate the relevance of their proposed work for ATM. The development of cockpit automation that is not relevant to ATM is out of scope.

  This element would benefit from air-ground integrated validation activities integrating the ground prototypes (covered in WA 3) and the airborne prototypes (covered in WA 5).

- **Flight-deck support for ATS B2 CPDLC v2/v4 on the airport surface.**

  This solution covers the development of the flight-deck (HMI, potentially including digital assistants, and avionics, including extension of push-to-load capabilities if needed), in support of the enhanced use of CPDLC on the airport surface. This includes an enhancement of the D-TAXI capabilities to allow the use of CPDLC to uplink taxi clearances when the aircraft is already taxiing, as well as for the uplink of a revised departure route at any point after the aircraft has left the gate until shortly before take-off. The new departure route could be a SID (i.e., one of the published departure routes from the airport) or a custom-made departure route (e.g., a published SID but with vertical constraints aimed at facilitating a better climb profile). This increased flexibility will make it possible to uplink departure routes shortly before take-off with vertical constraints to ensure separation with other aircraft so that aircraft fly more efficient vertical profiles. This applies in particular to the tactical uplink shortly before take-off of departure routes, potentially with vertical constraints. EFB applications supporting the implementation of ATS-B2 clearances and/or the downlink of

ADS-C data are also in scope. Note that the load of CPDLC clearances into FMS is not expected to go through the EFB but directly through direct connection between the CPDLC box and the FMS; EFB applications may be used to support the flight crew managing the clearances received via CPDLC (e.g., performance analysis, presentation, etc.).

This element would benefit from air-ground integrated validation activities integrating the ground prototypes (covered in WA 4) and the airborne prototypes (covered in WA 5).

- **Automation of QNH transmission between ground system and aircraft**

  The exchange of QNH information and the corresponding checks performed by ATS and the flight crew remain manual, increasing the workload for human operators. Moreover, the transmission of incorrect altimeter setting (QNH) between the ground system and the aircraft can lead to serious safety incidents[88]. Research aims at developing solutions for the complete automation of QNH transmission and checks between ground equipment and avionics without human intervention.

2.6.5.2 Topic HORIZON-SESAR-2025-DES-IR-02-WA5-2: Highly automated ATM for all airspace users

Expected outcomes

To significantly advance the following development actions:

- IR-5-03 **Highly automated ATM for all airspace users**. This includes performance-based CNS enablers (assured navigation for robust ATM/CNS environment for all phases of flight, alternative positioning, navigation and timing (A-PNT) providing enhanced robustness against jamming and spoofing, leveraging Galileo, electronic conspicuity, sense and avoid, enhanced distance measuring equipment (eDME), etc.) to facilitate the integration of advanced airborne automation and future ATC platforms, as well as accommodating IAM and interfacing with U-space.

Scope (R&I needs)

The following list of R&I needs is proposed as an illustration of the potential project content, but it is not meant as prescriptive. Proposals may include other research elements beyond the proposed research elements below if they are justified by their contribution to achieve the expected outcomes of the topic and are fully aligned with the development priorities defined in the European ATM Master Plan.

- **Development of on-board non-cooperative sensors in support of detect and avoid (DAA)**

  This research element covers the development of on-board non-cooperative sensors for crewed and uncrewed aircraft to detect intruders or other obstacles and enable a detect and avoid (DAA) capability (e.g., while flying in airspace with heterogeneous/mixed types of traffic or to detect unauthorised drones in controlled airspace). These non-cooperative sensors can

[88] https://bea.aero/en/investigation-reports/notified-events/detail/serious-incident-to-the-airbus-a320-registered-9h-emu-operated-by-airhub-on-23-05-2022-at-paris-charles-de-gaulle-ad/

scan the airspace and determine if certain measure of the sensor(s) can be associated to an object that represents a collision threat.

Non-cooperative sensors include electro-optical (EO) sensors, thermal / infrared (IR) systems, light detection and ranging (LIDAR) systems, radar and acoustic sensors, cameras, etc. Since each sensor has advantages over the others only in certain aspects, a multi-sensor architecture may be the best solution for developing a DAA system even if it can make the implementation more difficult.

Research shall consider:

- Define an effective DAA architecture based on non-cooperative sensors and develop an on-board DAA capability.
- Validation of the DAA capability in dense airspace and interoperability between different systems (ACAS-Xu, EUDAAS, TCAS, etc.).
- Determine the technical feasibility for detecting non-cooperative intruders and integration with the current collision avoidance algorithms.
- Definition of operational procedures for pilots reacting to electronic conspicuity and DAA.
- The integration of military operations (e.g., military IFR RPAS, etc.).
- Avionics certification and regulatory aspects shall be addressed.

Research shall consider the cost-effective, non-collaborative DAA solution developed by the IRINA project.

These technologies are civil/military dual use.

- **Enhanced automation support for space-launch management**

This element covers the development of enhanced procedures and enhanced supporting tools for the management of space-launch operations at the level of NM, local ATFM units and ATC. It includes space data integration (from Launch and Re-entry Operators (LRO), Launch and Re-entry site operators (LRSO), and STM with ATM) for specific operational scenarios (e.g. launch, re-entry, sub-orbital), contingency/emergency management and required external interfaces (local ATM services, outer regions, space agencies etc.). Note there is ongoing research on this topic in project ECHO 2.

- **IFR RPAS integration in airspace classes D to E**

Research aims at the full integration of IFR RPAS in airspace D to E, covering all types of uncrewed AU (fixed-wing, helicopters and VCA). The research shall address the integration of IFR RPAS in case of controlled airspace (class D and E). For controlled airspace, the impact on ATC of the use of DAA systems must be addressed, including a study of the compatibility of the RWC alert thresholds and the ATC separation processes. The safety case must pay particular attention to making the assessment considering the “work as done” for the management of crewed IFR vs. VFR separation in Europe in class D and E and investigate its applicability to the management of the separation between uncrewed IFR and VFR. Research may address the potential impact on capacity due to the increase workload caused by IFR RPAS.

The technological development of DAA systems is also in scope.

Note that there is on-going work by project IRINA SESAR solution 0380 "RPAS accommodated operations non-segregated in airspace classes D to G".

This element would benefit from air-ground integrated validation activities integrating the ground prototypes (covered in WA 4) and the airborne prototypes (covered in WA 5).

- **IFR RPAS integration in airspace classes F to G**

  Research aims at the full integration of IFR RPAS in airspace F to G, covering all types of uncrewed AU (fixed-wing, helicopters and VCA). It must be noted that crewed IFR operations in class G are not allowed in many European states, but they are allowed in some others. For the purpose of the research, it should be assumed that crewed IFR flight is allowed in class G, and the scope of the research is to extend the concept to uncrewed IFR flights. The technological development of DAA systems is also in scope. Note that there is on-going work by project IRINA solution 0380 "RPAS accommodated operations non-segregated in airspace classes D to G".

- **Safe integration of lower performance IFR RPAS in the European airspace**

  In the context of integration of remotely managed drone operations into the European airspace, there is a need for future research on lower performance certified[89] RPAS, particularly with regards to low size weight and power (SWaP), including:

  - Smaller low-power DAA systems for their integration in controlled airspace (classes A-E) and uncontrolled shared airspace (classes F and G), considering both cooperative and uncooperative targets. Encounter models should also be enhanced for this domain including small light non-cooperative targets.

  - Smaller low-power IFR equipment, and research into potential adaptation of IFR procedures and ATC clearance for these vehicles.

  These technologies and concepts are civil-military dual-use.

  This element would benefit from air-ground integrated validation activities integrating the ground prototypes (covered in WA 3) and the airborne prototypes (covered in WA 5).

- **Dual-frequency multi-constellation (DFMC) global navigation satellite systems (GNSS) based on satellite-based augmentation system (SBAS) / aircraft-based augmentation system (ABAS) receivers**

  Research aims at developing DFMC GNSS/SBAS/ABAS receivers and additional avionics systems processing GPS and Galileo signals in L1/E1 and L5/E5, considering architectural considerations, assessing transitional aspects, and exploiting synergies and

[89] Note that open and specific category drones are covered in WA 6.

complementarities between different augmentations (DFMC ABAS (advanced receiver autonomous integrity monitoring) and DFMC SBAS) in nominal and degraded modes.

Consideration of requirements on backwards compatibility and joint airborne architecture for ABAS /SBAS / GBAS (see WA3-2 on GAST-E) receivers / avionics equipment (avoiding the need for multiple avionics) and joint airborne architecture for GAST-E and SBAS.

The aim is to deliver a more robust navigation performance solution including resilience to radio frequency interference (RFI) (jamming and spoofing), supporting enhanced approaches and optimised descent operations for CAT II and/or CAT III that will allow to reduce noise footprint, fuel consumption and emissions.

- **High-altitude operations (HAO) GNSS and inertial sensors**

  This research area refers to the expansion of navigation infrastructure is necessary to meet the demands of high-altitude pseudo-satellites (HAPS), supersonic and hypersonic aircraft, and space launches. This may involve the performance assessment of GNSS systems supplemented with inertial systems to serve as backup during temporary GNSS outages caused by high-speed plasma formation or space radiation effects.

- **Airborne-based alternative – Position, Navigation and Timing (A-PNT)**

  Global navigation satellite systems (GNSS) including Galileo and the European geostationary navigation overlay service (EGNOS), are usually considered as suitable technologies for providing position, navigation, and timing (PNT) information as required. However, GNSS can be subject to local (e.g., interference, spoofing, jamming) or global (ionospheric issues, system fault) outages, and it also presents service limitations in those areas where there is limited sky visibility.

  With the objective of having a back-up solution for GNSS as the source of PNT in the situations above, several potential technological solutions have been or are being developed to provide alternate position navigation and timing (A-PNT). The proposed solution will therefore enhance service resilience (e.g., to RFI), availability, and continuity. This requires the support of industry standards to ensure the required interoperability. The proposed solutions should investigate how their developments fit into the larger cross-domain European complementary PNT (C-PNT) framework (note that there is on-going work under MIAR solution 0336 “LDACS-NAV solution & Modular Integration of A-PNT technologies solution” to the technologies mentioned below. The notion of C-PNT aims at building a larger European PNT ecosystem to mitigate the risk of PNT service interruption, which includes GNSS and several complementary emerging alternative systems.

  Research shall address the different options for time synchronisation (in particular during GNSS outages). On this point, note that there is on-going work by project MIAR SESAR solution 0336 “LDACS-NAV solution & Modular Integration of A-PNT technologies solution”.

  This research element includes the development to TRL6 of new A-PNT solutions that are aircraft-based, including but not restricted to:

  - Radar-based navigation for approach phase: research shall aim at developing and validating additional navigation aiding solution based on vision (airborne active radar sensors), and to ensure that the accuracy and integrity of solution fulfils the demanding requirements of the approach phase in all weather conditions. Occasional GPS outage / degradation shall also be considered.

  - A-PNT for small aircraft (including RPAS, and VCA) and drones combining navigation data from multiple constellations (e.g., GALILEO and GPS) with inertial measurement unit (IMU) based on atomic gyroscopes (low-cost inertial reference systems). The objective is to develop cost-effective A-PNT solutions that can be used by small aircraft (and drones) to ensure navigation performance levels consistent with evolving airspace and air traffic. Research shall consider the results of exploratory research project NAVISAS (TRL2).

Other technologies may be under scope, provided that they meet accuracy, availability, continuity, and integrity requirements.

The research may address the provision of an assured navigation by realization of the C-PNT solution onboard the aircraft, utilizing various sources for navigation (e.g., GNSS, INS, DME/DME (eDME), Mode N, etc.) and providing RFI resilience by jamming & spoofing detection and mitigation. In the area of spoofing detection, the research may address the development of Galileo Open Service Navigation Message Authentication (OSNMA) airborne receivers.

The research may also address combined GNSS-inertial systems (leveraging inertial sensors) and other augmentation to increase navigation accuracy, integrity, and continuity when GNSS is fully functional or partially unavailable.

2.6.5.3 Topic HORIZON-SESAR-2025-DES-IR-02-WA5-3: Airborne capabilities for supporting reducing ATM environmental footprint

Expected outcomes

To significantly advance the following development actions:

- IR-5-04 **Airborne capabilities for supporting reducing ATM environmental footprint**. This includes wake energy retrieval (WER), energy-based operations, and environment driven trajectory optimisation, etc.
- IR-3-08 **Geometric altimetry**.

Scope (R&I needs)

The following list of R&I needs is proposed as an illustration of the potential project content, but it is not meant as prescriptive. Proposals may include other research elements beyond the proposed research elements below if they are justified by their contribution to achieve the expected outcomes of the topic and are fully aligned with the development priorities defined in the European ATM Master Plan.

- **Environmentally driven trajectory planning**

  Research aims at developing technologies and operational concepts to allow the planning of more optimised trajectories by considering both CO_2 / non-CO_2 effects in the aircraft trajectory planning. Research shall assess the need and if required develop sufficiently accurate models (e.g., aircraft performance, climate impact, etc.) to support efficient trajectory optimisation. Research shall integrate different inputs (e.g., CO_2 emission profiles, eco-sensitive regions (i.e., regions where non-CO_2 effects (e.g., contrails, NO_x, etc.) are significantly important), aircraft dynamical models, and define potential optimisation algorithms for trajectory planning. Airline trajectory optimisation plays an important role on the global environmental mitigations. However, and since adopting independently optimised trajectories may not be always operationally feasible, the proposed algorithms shall consider air traffic management aspects such as safety, traffic demand, complexity, etc. Environmentally driven trajectory optimisation shall include enroute and terminal areas. The optimisation in the terminal areas shall consider both noise, non-CO_2 and CO_2 including potential trade-offs. The research element should address the update of computerised flight plan service products, FMS updates and/or the development/update of EFB applications. The development of improved aircraft (e.g. for new aircraft, or more accurate models of existing aircraft) or climate models is also in scope. Note the integration of FOC, EFB and FMS is covered in WA 1-1.

Since adopting independently optimised trajectories may not be operationally feasible, the proposed algorithms shall be able to consider constraints expected from ATM (e.g. constraints from NM, be them RAD constraints or constraints imposed specifically to a flight, ATC constraints, LoA). The algorithms may incorporate a concept for considering the probability that an ATM constraint will actually be applied in execution as part of the planning. Potential use cases of the probabilistic approach to flight optimisation include, for example:

- If a LoA or RAD constraint for an early descent is expected to be waived, the flight plan could be optimised under the assumption it will be waived.
- if a shortcut is usually expected on a specific route, the flight plan may be optimised under the assumption the DCT will happen, even if the flight plan needs to file with the full route without the DCT.

- **Wake energy retrieval (WER)**

WER operations allow aircraft to reduce fuel-burn by flying closely behind another aircraft, thus taking advantage of some of the residual lift of the leader. From an ATM point of view, the challenge is to identify WER candidate pairs, manage the rendezvous and then the pair when formed. In low-density airspace, continental airspace and/or oceanic/remote airspace, previous R&I has laid the operational foundations supporting WER entry into service for limited number of pairs. Research shall address the development and validation of a concept of operations for scaling up the WER concept to higher pair frequencies and the remaining en-route operational environments, considering the outcomes and results of previous projects on the topic. The research must cover both the ground and airborne technical developments and procedures, with a particular focus on support tool integration in common FDP systems as well as suitable automation steps to enhance ATCO efficiency when handling multiple WER operations or requests. The whole process must be addressed, starting with the flight planning phase (with inclusion of WER equipage information in the flight plan), the identification of candidate pairs, the actual ATC clearances required to put the two aircraft in a situation where the pairing manoeuvre can start, the ATC clearance for the pairing manoeuvre, the control of the flights by ATC during the WER operation and the ATC clearance to unpair. Tools for monitoring network WER operations for performance assessment purposes are also in scope.

Research shall address air to air (A/A) communication to enable new operations such as WER, defining the operation needs and requirements that should drive the developing of the associated technical capabilities.

In addition to contributing to the operational validation of such aircraft and ground capabilities, the research must pave the way to the standardisation and certification of the new airborne and ground systems, as well as support the adoption of WER at a global level through ICAO.

Note that there in on-going work under project GEESE.

This element would benefit from air-ground integrated validation activities integrating the ground prototypes (covered in WA 3) and the airborne prototypes (covered in WA 5).

- **Environmentally friendly TMA operations through combined dynamic management of aircraft configuration and navigation and route structure**

  The research aims at enhancing flight management system on the one hand, which advises the pilots to perform the flight more optimally. It includes the required aircraft configuration with allowing a flight along the lateral path of the permanent resume trajectory (PRT) and the newly calculated optimal vertical profile from the FMS by the autopilot or (semi-)manual flight with commanded selections by the pilots. In both ways, modern aircraft flight control architectures can cope with the foreseen FMS enhancements for arrivals and departures as these have strong influence on the noise Impact. Furthermore, new communication ways will ensure the required data exchange to provide the enhanced functionalities. On the other hand, new airspace management techniques and related support tools open the path for more optimal routing of aircraft in the terminal manoeuvring area (TMA) enhancing the airspace capacity with more environmentally friendly operations at the same time while further maintaining and ensuring today's safety level. The proposed solutions shall address not only arrivals but also departures as these have strong influence on the network capabilities. This research includes the development of avionics and procedures to improve vertical navigation in all phases of flight, including energy management in the descent, implementation of strategic or tactical vertical constraints and monitoring of their compliance, etc. Note that there is on-going work on this research element by projects DYN-MARS (working also on procedural aspects in relation with route structures dynamicity) and GALAAD.

  This element would benefit from air-ground integrated validation activities integrating the ground prototypes (covered in WA 3) and the airborne prototypes (covered in WA 5).

- **Voluntary mitigation of climate impact for individual flights in low-density/low complexity traffic situations at AU initiative**

  This research element covers the update of state-of-the-art FOC and/or EFB applications to implement a multi-objective flight planning via the integration of via the integration of climate impact models (e.g., algorithmic climate change functions) with the goal to consider the overall climate impact (CO_2 and non-CO_2 effects) of a flight while ensuring the compliance with conventional flight planning boundary conditions and operational constraints. The proposed solutions shall consider the impact on the uncertainty in weather forecast (e.g., persistent warming contrails forecasts based on any observation technologies available). From a conceptual point of view, the enabler solution developed could be implemented in different phases of the flight planning process, comprising strategic and tactical flight planning and even a revision of the flight plan during the execution phase.

The climate optimised trajectories may require unusual flight profiles in the vertical dimension (e.g. eco-yoyo flights, unusually low requested cruising level, longer track miles than expected by ATM). These unusual profiles are difficult to manage for ATM. The objective of the research is to facilitate that AU who so desire can fly these unusual profiles whenever safety is not compromised. Note that the concept could be applied to any airspace (including high density/complexity) at periods of low traffic demand/ low traffic complexity. Research should develop a concept to assess in operations until which level of traffic demand / traffic complexity this approach is operationally feasible. When not feasible, a coordinated approach should be applied as described in WA3-1 (research element "Network-orchestrated avoidance of eco-sensitive areas").

Research considers:

- These unusual flight plan profiles may need to be flagged to avoid that they are rejected by the IFPS, and NM systems may need some adaptation to process them.
- ANSPs shall also have the information that these flights are flagged for environmental reasons.
- A process for local ATFM units to assess the increased workload/complexity caused by these flights and whether it is feasible to handle them (e.g., unusual profiles to be accepted whenever the sector demand is below XX% of the maximum capacity).
- ATC support tools to provide service to eco-yoyo flights (e.g., FDPS adaptation, ATC support to ensure timely climb or descent as per the yo-yo profiles, etc.).

The research may also include support for flights requesting unusual profiles directly to ATC instead of doing so in the flight plan (e.g., development of phraseology). A concept could be considered for declaring an eco-sensitive area of the airspace (i.e., areas where warming contrails are predicted) as eco-yoyo-friendly when traffic demand allows.

- **Environmentally optimised operations with geometric altitude**

Since the early days of aviation, barometric pressure measurements have been a simple and robust method for altimetry. Two drawbacks exist though: there is no direct reference to terrain, and the constant variations in pressure caused by the weather leads to increased vertical profile variability restricting capacity and flight efficiency in today's high traffic density.

Research shall investigate the potential of extending the use of geometric altimetry enabled by satellite navigation to increase safety and deliver environmental benefits. The following elements are in scope:

- Earlier barometric to geometric transition in the approach: the objective is to facilitate a smoother descent by anticipating the switch from barometric to geometric guidance. It can also support a reduction of the length of the segment of the approach path that is required to be aligned to the runway. This element requires a proposal for an update of the procedure design in PANS OPS. The work of PJ.02-W2-04.3 "advanced curved approach operation in the TMA with the use of geometric altitude" must be considered. Note that there is on-going work on this research element by project Green-GEAR.

- Extension of the geometric altimetry concept in the climb/descent phase up to, or through, the transition layer: the objective is to eliminate the need for QNH setting, so that in geometric-altimetry airports/CTRs/TMAs aircraft would fly with respect to geometric altitude below a defined transition altitude (above which barometric altimetry with QNE would continue to be used). When going through the transition layer, aircraft would switch to/from geometric from/to barometric, or remain in geometric until enroute, instead of the current from/to barometric with respect to QNE to/from barometric with respect to QNH. The research should investigate if geometric altimetry based on GNSS without augmentation as per the current GNSS and IRS navigation paradigm in place (outside of specific approach procedures requiring augmentation, e.g. LPV, GLS) is sufficiently accurate or augmentation would be required. The flight-deck HMI needs to be developed to make both geometric altimetry and barometric altitudes available, and both altitudes should also be downlinked to ATC systems. The aircraft flight path control systems (FMS and autopilot) will also be affected (note that there is on-going work on the FMS by Project DYN-MARS). The research should also study the feasibility of a mixed barometric/geometric altimetry environment, including a quantification of the barometric vs. geometric altitude differences and research on how the vertical separation process would be affected. Impact on the development and readability of aeronautical charts should also be studied (e.g., publish both barometric and geometric minima vs. single geodetic/MSL minima with a sufficiently high transition altitude). The specific needs and constraints of general aviation must be considered.

- Geometric altimetry above the transition layer: in a geometric cruise, aircraft do not have to climb/descent when flying across isobars to maintain a constant altitude, but thrust settings need to be adapted to outside air pressure changes. The research must analyse the environmental impact in terms of fuel burn these two opposing effects would have and if possible, conclude with a go/no-go recommendation for this concept. If recommendation is to go ahead, the research should continue building on the previous point for geometric altitude below the transition layer.

- Potential reduction of separation minima thanks to more precise altimetry: the increased precision of the altimetry is expected to allow a reduction of vertical separation minima to 500 ft. for some aircraft type pairs (based on the results of a preliminary research on this topic conducted by SESAR project R-WAKE). The research should build on the R-WAKE project research to investigate this potential reduction of minima in different environments from the safety perspective and provide an estimation of the benefits it would provide.

Note that there is ongoing research on the transition to geometric altitude in SESAR project Green-GEAR and that in this call WA 6-2 there is an element addressing altimetry for drones. While it may not be required that open and specific category drones and certified aircraft use the same altimetry system, projects working in altimetry for drones and projects working in altimetry for certified aircraft should share information and consider interoperability at low altitude or applicable buffers for separation.

This element may benefit from air-ground integrated validation activities integrating the ground prototypes (covered in WA 3) and the airborne prototypes (covered in WA 5).

2.6.6 Work Area 6: U3 U-space services, IAM and vertiports

This working area focuses on enabling IAM operations with vertical take-off and landing capable aircraft (VCA) and uncrewed aircraft systems (UAS) in complex environments and congested areas including vertiport integration as an inherent component of an efficient and sustainable multi-modal transportation system. This will be supported by the development of U3 U-space services which, building on U1 and U2 U-space services under implementation following Commission IR 2021/664[90], will enable IAM integration into all types of airspace and vertiports under both instrument meteorological conditions (IMC) and visual meteorological conditions (VMC), etc.

Specific conditions for WA6	
Expected EU contribution per project	The SESAR 3 JU estimates that a maximum EU contribution of EUR 5.00 million would allow these outcomes to be achieved. Nonetheless, this does not preclude the submission or the selection of a proposal requesting a different amount.
Indicative budget	The total indicative budget for this work area is EUR 20.00 million.
Type of actions	Innovation action (IA)
Procedure	The procedure is described in General Annex F to the Horizon Europe work programme for 2023–2025. The following exception applies: to ensure a balanced portfolio, grants will be awarded to applications not only in order of ranking but at least also to those that are the highest ranked within topics within the same work area, provided that the application attains the threshold.
Other requirements	The maximum project duration is 36 months.

2.6.6.1 Topic HORIZON-SESAR-2025-DES-IR-02-WA6-1: Fast-track U3 U-space advanced services and CNS capabilities

Expected outcomes

To significantly advance the following development actions:

- IR-6-01 **U3 U-space** advanced services addressing aspects such as common altitude reference, collaborative interface with ATC, tactical conflict detection and resolution, fairness in strategic deconfliction, etc.

Scope (R&I needs)

[90] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021R0664#:~:text=This%20Regulation%20lays%20down%20rules,provision%20of%20U-space%20services

The following list of R&I needs is proposed as an illustration of the potential project content, but it is not meant as prescriptive. Proposals may include other research elements beyond the proposed research elements below if they are justified by their contribution to achieve the expected outcomes of the topic and are fully aligned with the development priorities defined in the European ATM Master Plan.

- **Collaborative interface with ATC: dynamic airspace reconfiguration (ATM/U-space)**

  Research shall further develop dynamic airspace reconfiguration (DAR) concept to facilitate that UAS traffic can access ATC controlled areas, ensuring the safe separation of UAS and crewed operations. Research objective is to develop a highly dynamic, responsive, and granular delegation of portions of controlled airspace in the ATM–U-space shared airspace (AUSA) to either ATC or U-space control, subject to ATM and U-space operational demands respectively. Research shall address the definition of ATM and UTM responsibilities and may address the impact on ATM and UTM capacity. AUSA is a region of controlled airspace where airspace delegation between ATM and U-space can occur.

  The volumes in AUSA may extend from ground or a specified altitude and have a ceiling that may reach into any altitude of the controlled airspace. The horizontal shape and vertical boundaries of each volume can dynamically change before and during execution of an operation in AUSA. This can effectively create a “safe bubble” around the crewed aviation in those cases when most of the AUSA airspace is delegated to U-Space.

  The research must consider the specific needs of military/state drones. Note that there is on-going work under project ENSURE.

- **Operation of open and certified drones in controlled airspace without dynamic airspace reconfiguration (DAR)**

  This element aims at creating a concept for the operation of drones in controlled airspace that is not AUSA. It can also be used in AUSA as an alternative to DAR, e.g. to allow the operation of a single drone for which DAR is not practical. The first target use case is the operation of drones at controlled airports, e.g. for airport service activities (surveillance, delivery, NAVAID calibration). In this case, the drone will follow an ATC clearance. Communication between the drone pilot and ATC will be facilitated by a U-space service. The research must establish whether direct communication between the drone pilot is required. Acceptable clearances and minimum performance requirements for the drone may be required for this kind of operations, and the drone pilot may be required to undergo specific training (e.g. similarly to what is required for operating airport vehicles).

- **Enhanced drone flight authorisation processes**

  As per the current regulation, to operate a flight in U-space airspace the operator must submit a drone flight plan to the U-space service provider (USSP), which the USSP must issue an authorisation for. For a flight plan to be accepted/authorised, it needs to comply with all known airspace constraints (e.g., geographical zones) and be strategically deconflicted from other drone flight plans. The objective of the research is to contribute to further develop the drone flight plan standard (including both data format, data exchange protocols and processes) beyond the existing (e.g., ASTM F-3548-21[91]) to include enhancements, such as:

- A two-step authorisation process, with first a drone flight plan acceptance to be followed by an authorisation to proceed (equivalent to a clearance for take-off) to be issued shortly before the flight moves to an activated status. Where the two-step process is not deemed necessary, the two authorisations will be issued simultaneously. The drone flight acceptance would be issued if the drone flight plan is complete and does not infringe any airspace restrictions, while the authorisation to proceed would be given after the applicable strategic deconfliction process has been completed. Both authorisations would have a time tolerance attached.
- The introduction of a limited authorisation option, where a flight plan is authorised to an (airborne) clearance limit rather than all the way to destination. Before proceeding beyond the clearance limit, the drone operator will need to receive an authorisation to proceed. This kind of authorisation is expected to be particularly useful for drones conducting successive inspection operations where the time the drone will need to spend over each of the inspection targets can't be known in advance.
- Definition of non-first-in-first-out (non-FIFO) fair prioritisation rules in pre-departure strategic deconfliction, allowing the prioritisation of the flight authorisation for e.g. state or medical drones, or for ensuring a fair competitive environment for all drone operators. Note that a non-FIFO prioritisation rule that is not based on a FIFO principle[92] may require the revocation or amendment of an authorisation previously given to a lower priority flight to be able to authorise a higher priority flight.
- Inclusion of flight permission to fly in certain geozones as part of the digital U-space flight authorisation process.
- Update flight authorisation standard to include new elements from undergoing projects, such as vertiport selection and slot reservation.
- Interoperability between USSP and common information services (CIS).
- Standard to cover actual flight plan (not just interoperability between USSPs).

Research shall consider the dataset in the appendix of the regulation and may investigate the potential benefits of using additional data fields. The format of flight plan should be standardized and include all the required information (same info to be exchanged between USSPs, between USSP and user, between USSP and CIS), although research may conclude that some fields might not need to be exchanged between USSPs. Research shall address the time

[91] Standard Specification For UAS Traffic Management (UTM) UAS Service Supplier (USS) Interoperability.

[92] FIFO schemes include, e.g. the first-filed-first-served scheme, whereby flight authorisation requests are processed sequentially in the order they are received, i.e. a flight will not be authorised until all the flights that have previously requested an authorisation have been authorised. An alternative FIFO approach could be that requests could be processed in batches according to milestones, e.g. XX minutes before a take-off-time-interval, with authorisations being processed sequentially based on the planned take-off time.

dimension of the authorisation process (e.g., when the authorisation process starts, when the process finishes, etc.).

To facilitate ATM-U-space interoperability the data formats should be as close as possible to the standards used for crewed aviation. The applicability of the SWIM standards for USSP-USSP-CISP data exchange should be investigated (e.g., publish/subscribe).

Note that CISP USSP interface is defined in EU IR 2021/664 and EU IR 2021/665 and their associated AMC/GM.

- **U-space tactical separation management service for drones**

  Separation is defined as the tactical process of maintaining drones above the separation minima (between themselves or between a drone and a restricted access geozone). When it is foreseen that the distance will be below the separation minima (based on the information available from a trajectory prediction based on tracking and flight plan information), the tactical separation service will provide a modification of the trajectory to the drone or drones involved through the USSPs. When the trajectory of two or more drones needs to be modified, more than one USSP may need to be involved.

  The primary objective of the separation service is to allow drones to receive flight authorisation for beyond visual line of sight (BVLOS) flight without the requirement that the planned trajectories be strategically deconflicted as currently required by the current U-space easy access rules in areas where the ground risk is such that the risk of collisions between drones needs to be mitigated. For areas with higher ground risk (e.g., over densely populated areas) a separation service may be the preferred option. It is expected that the implementation of the route modification proposed by the separation service will be mandatory for users having accepted a flight authorisation without prior strategic deconfliction (flight authorisation with tactical separation commitment). If time allows the drone operators or the USSPs may propose an alternative to the route modification proposed by the separation service. The research must define the process to define the separation minima, which may be dependent on the drone capabilities. The deconflictions (e.g., lateral deviation, vertical deviation, speed change, etc.) should consider the uncertainties in the current and future positions, for example relating to the altimetry system.

  A tactical separation service may also make it possible for a USSP to grant authorisation for a drone to fly when there is uncertainty on whether it might find airspace restrictions along the route (e.g. if a restricted access geozone might become active). The separation between drones and crewed VFR aircraft entering U-space airspace is covered in the dedicated element “Separation between uncontrolled crewed VFR flights and drones”. The research may explore the synergies between these two separation services.

  Research could also consider a combined strategic/tactical concept where some degree of pre-departure strategic deconfliction is still required, but there is a tactical separation service to cover the non-nominal situation where two or more drones are predicted to become closer than defined tactical and/or strategic separation minima, e.g. due to one or more drones having deviated from their flight authorisation beyond the allowed or expected buffers. In this context, the term tactical separation service refers to any modification to the authorisation of a drone flight that is already airborne, regardless of the time ahead from the current drone position where the new authorisation deviates from the original authorisation. When two or more drones are involved in the separation loss, a fair prioritisation framework may be defined to decide which drone (or drones) should be asked to change their trajectory (when time allows). Note it is expected that the buffers for the strategic deconfliction in a combined strategic/tactical concept could be lower than in the current strategic-separation-only concept.

Research shall consider scenarios including simultaneous operations of drones with different capabilities. The research output shall include operational concept and technical requirements including CNS requirements. Note that there is on-going work under projects SPATIO and U-AGREE.

- **Enhanced ground risk assessment**

  The aim of the research is to provide automated support for the assessment of the ground risk of drone operations (the proposal should provide means to obtain the dynamic population density as per specific operations risk assessment (SORA) 2.5 plus subsequent versions, and also explore other risks and inputs useful to be included in enhanced guidelines to perform airspace risk assessment (ARA)). The basis for the ground risk assessment is expected to combine multiple information sources and be applicable both before the flight and during the conduct of the flight:

  - Before the flight: platform for municipalities/authorities to evaluate the increase or decrease of the ground risks due to events (e.g., opening/closure of public spaces, festivals, sports events, etc.), consider historical mobile phone concentration and camera data, etc. At the same time, digital means to communicate this information to drone operators, both inside and outside U-space should be provided, updating (in the case of drone operations within U-space airspace) automatically the flight authorisations.

  - In real time (during the flight execution): consider live camera and mobile phone data, platform for municipalities/authorities to report issues, etc. As in the previous case, digital means to communicate issues by municipalities and authorities should be provided, updating (in the case of drone operations within U-space airspace) automatically the flight authorisations in real time.

  - Governance mechanisms to dynamically report and implement changes on UAS zones due to events or disruptions affecting the ground risks should be established and taken into account when defining digital means or platform to report this information to drone operators.

  - Research shall take into consideration U-space lifecycle and coordination for U-space airspace establishment under Article 18.f of 664 Implementing Rule.

  Research shall address the potential needs of a secured and trusted data base to support the elaboration the ground risk assessments.

  Proposals shall elaborate a thorough state-of-the-art analysis on U-space ground risk management including relevant previous R&I work (both in and outside of SESAR).

  Research shall take into consideration the work done under EASA on this element. Research may address the potential use of satellite data from the European Union Agency for the space programme (EUSPA) and from the statistical office of the European Union (EUROSTAT) regarding population data. Note that there is on-going work under project U-AGREE.

- **Enhanced geofencing service**

  Geofencing allows U-space geographical zones with restricted access to be loaded into a drone pre-departure, potentially including mandatory update before each take-off, and may also include in-flight update. The concept includes the prevention of non-authorised flight at the level of the drone software. Geofencing is a useful mechanism to prevent accidental unauthorised entry into areas where drone flight is restricted, increasing safety levels (for example around airports and over sensitive areas over critical infrastructure or security-sensitive areas, etc.). The technology is mature and standardized (ED-269, ED-270 and ED-318), but there is a need to set up the framework to allow its widespread adoption. The gaps include database management framework, legal and liability issues, U-space services to process users' authorisation to fly inside a restricted zone and specific processes to allow full access to state drones (e.g., police drones, border control, etc.). Note that geofencing is an option in the current regulation within the geo-awareness service.

  Proposals shall elaborate a thorough state-of-the-art analysis on geofencing including relevant previous R&I work (both in (e.g., project Geosafe) and outside of SESAR), and not limited to European context. Research shall consider the recommendations included in the EASA report "study and recommendations regarding unmanned aircraft system geo-limitations"[93].

  Research shall include a study of documented drone incidents that might have been prevented with a geofencing system to support the safety case.

  Geofencing is a dual-use civil-military concept and technology. The project should consider the specific geofencing needs from the military community.

- **Low-ground-risk DAA-based drone operations in drone only geozones**

  The objective of these research is to develop and validate a concept for the operation for small drones to operate over areas where there is no crewed aviation and with low-ground-risk without a requirement for pre-departure strategic deconfliction, where collisions between drones are prevented by the on-board DAA systems. When two drones are in conflict, the two DAA systems could coordinate with each other, for example based on a wifi connection as considered by previous SESAR project PERCEVITE. The concept must include a process for flight authorisation without strategic deconfliction of the planned 4D volumes, which could consider a DCB process to ensure a maximum density of operations as part of the criteria for approval. The capacity of airspace should be dynamically defined, e.g. there would be a default capacity, but it could be reduced in case of an increase in the ground risk (e.g., seasonally or due to an event) or the air risk, or under certain meteorological conditions.

  Air-risk must also be mitigated. It is envisioned that the operation would be restricted to very low level (VLL). An altitude buffer below the upper level of VLL (500 ft) should be defined and validated. The size of the buffer could depend on the altimetry used by the drone (e.g., barometric, geometric GNSS, geometric real time kinematic (RTK), etc.) and on the capability of the drone DAA system to detect and avoid crewed aircraft. Both cooperative and non-cooperative crewed aircraft flying above VLL must be considered.

[93] Study and Recommendations regarding Unmanned Aircraft System Geo-Limitations | EASA (europa.eu).

It is envisioned that the concept could be applied only in geographical areas where there is no crewed aviation. Even in this case, the safety case must address the contingency of a crewed aircraft entering the drone-only due to a flight emergency (e.g., via DAA). Planned crewed flights e.g. for a helicopter flight landing or military aircraft doing low level training should also be addressed (e.g., by DAA in combination with the provision of real-time information on the crewed flight plan to the drone operators via the USSP). Flight authorisation could be given for a limited time (e.g., 15 min) and be confirmed every 15 min. Proposals shall include an airspace risk assessment.

If the research is successful, a regulatory evolution should be proposed (e.g., for a new type of U-space airspace with different flight authorisation rules for these DAA-based operation areas).

- **Altimetry for drones in very low level (VLL)**

  The objective of this research element is to provide altimetry solutions for drones. Both barometric and geometric altimetry solution should be considered. The research must study the comparative benefits of barometric vs. geometric altimetry for drones and investigate the operational impact of having drones with barometric and geometric altimeters flying in the same airspace volume (e.g. buffers in the separation minima to account for the different reference systems), and the comparability with QNH-corrected altimeter readings from certified aircraft.

  - Barometric: when below the transition layer, barometric altimeters in (crewed or uncrewed) certified aircraft correct based on the local pressure at the airport or region via the use of the QNH setting. All aircraft flying in an airspace volume use the same QNH setting, which makes it possible to compare their altitudes and apply vertical separation between them. In contrast, small drones that use barometric altimeters use the pressure differential with respect to the take-off “home point”. If the elevation of the home point is known (e.g., from GNSS or from a chart), a QNH-like setting can be generated and used to correct the barometric altitude, hence providing a reasonably accurate altitude above MSL. However, drones taking off from different home points could have different QNH-like correction settings, which might make their altitudes not comparable in the general case (although the difference between the settings for drones taking off from sufficiently proximate home points might be negligible). The use of a regional-type QNH-like altimeter correction setting for drones could be used to ensure a common reference but would result in drones potentially having a non-zero altitude reading at the home point. The research should investigate the different options to make barometric altitudes from drones with different home points comparable, e.g. correction based on known elevation of home point for proximate home points (proximity parameter to be defined), use of regional correction settings for all drones in a specific volume, etc. The research should also investigate the comparability of altitudes between drones using barometric altimetry with some type of home-point or regional correction and QNH-corrected barometric altitude from certified aircraft.

  - Geometric: geometric altimetry for drones is GNSS based and can use different means e.g., EGNOS, GBAS, real time kinematic (RTK) augmentation etc. to increase its precision. The research on geometric altimetry shall consider the research performed by SESAR project ICARUS. The research must characterise (providing a quantification) the comparability between geometric altimetry of drones with/without augmentation and aircraft flying with a QNH, focusing on the VLL airspace (500 ft or below).

The following additional altimetry-related areas of research are also in scope:

- Altimetry in the network identification and tracking reports from drones: drones provide altitude information through the tracking and remote identification services. For each of the altimetry methods considered in the research, the project should assess potential impact of using the method for reporting altitude in the network identification and tracking transmissions.
- Digital surface model (DSM) and digital terrain model (DTM) database management, including business aspects and service provision.
- Augmentation systems for increasing the precision of vertical altimetry in urban environments (e.g., EGNOS, GBAS, multi-drone cooperative, navigation using anchor vehicles, etc.).

The research should avoid proposing solutions enforcing additional requirements to other airspace users (in particular general aviation) and should be easy to understand for non-aviators (considering drone pilots in the open and specific categories). Applications to support the situational awareness of drone pilots in terms of altimetry are in scope.

Note that in this call WA 5-3 there is an element addressing altimetry for certified aircraft. While it may not be required that open and specific category drones and certified aircraft use the same altimetry system, projects working in altimetry for drones and projects working in altimetry for certified aircraft should share information and consider interoperability at low altitude or applicable buffers for separation.

- **Separation between uncontrolled crewed VFR flights and drones**

  According to the standardised European rules of the air (SERA), except for take-off and landing, crewed aircraft must maintain an altitude of 1000 ft. or above the highest obstacle within a radius of 600 m when flying over cities, towns or settlements or over an open-air assembly of persons, and 500 ft. or above elsewhere. The U-space regulation allows BVLOS flights in U-space airspace subject to flight authorisation and specific operations risk assessment (SORA). U-space airspace is typically expected to be designated to cover up to 500 ft, but a higher boundary is also possible. The objective of the research is to investigate a concept to mitigate the risk of collision between crewed VFR aircraft and drones, examining different use cases:

  - When the VFR aircraft is taking off or landing in U-space airspace. In this case, the U-space regulation requires that the VFR aircraft is e-conspicuous, and hence the USSP will have real-time position information. The concept should assess conflict management between drones a crewed VFR aircraft for which only the e-conspicuity information and evaluate the potential benefits of making additional information available to the USSP (e.g., the flight plan (allowing the USSP to anticipate that a VFR aircraft will take off or land), information from a flight information service (FIS) service if available, etc.).

- When the VFR aircraft is entering very low level (VLL) due to an emergency, and it is e conspicuous.
- Military low-level training operations.
- When the VFR aircraft is entering VLL due to an emergency. It is not e-conspicuous (as the entrance in VLL was unplanned, the VFR aircraft may not be equipped, or the equipment might not be switched on). In this case, the drone might use to detect the crewed aircraft. The research could investigate mitigation options for this case, e.g. use of electro-optical or sound detection equipment and DAA by drones flying below areas of intense VFR traffic and/or requirement for e-conspicuity for crewed VFR aircraft flying directly above U-space airspace.
- On the top boundary of U-space airspace: this is the case when the VFR aircraft is flying close to the ceiling of U-space airspace (typically VLL ceiling will be 500 ft, but it could be higher if the state has declared a U-space airspace with a higher ceiling) and the drone if flying just below the U-space airspace ceiling. In this case, the mitigation may include determining a maximum altitude drones should receive authorisation to fly at (e.g., 400 ft. for a U-space airspace ceiling at 500 ft) so that they stay always at a safe distance below crewed aircraft).

Research shall consider use cases including sports aviation (e.g., gliders, paragliders, ultralights, balloons, etc.), which usually do not need to file a flight plan.

The research must consider the altimetry systems used by drones and by crewed aircraft and investigate if an additional buffer is needed.

- **Multidimensional optimised U-space flight planning and authorisation processes**

Work is required to ensure that the new operations enabled by U-space are acceptable to the public. Specific areas of concern will be innovative air mobility (IAM) noise, visual pollution, privacy, urban and rural development, protection of natural environments, employment generation, etc. The introduction and growth of IAM must be carefully assessed and managed to ensure equity and sustainable improvement with regards to quality of life.

Research shall address the definition of a cost function for each mission including factors proven to have an impact (e.g., societal acceptance/visual pollution, noise, CO_2 emissions, meteo, energy consumption, etc.) to be considered already in the flight planning process. This could give incentives to U-space operators to choose an optimised mission considering all relevant dimensions.

In addition, a consensus must be reached on the acceptable target level of safety of the different types of operations under U-space. The traditional definition for target level of safety may not be enough to encompass the context of U-space 2.0 and IAM operations (e.g., restricted geo-zones breach is not an accident, nor it would necessarily cause harmful effects to people but still considered unacceptable). Both real and perceived levels of safety should be considered. Responsibility, accountability, and liability are further fundamental societal concerns that must be considered. Allowing citizens to be involved in the overall development of the system is crucial to ensuring their consideration. General and leisure aviation needs should also be considered, especially when they are not subject to ATC.

- **Counter-UAS (C-UAS) systems' services for airport operations**

The presence of drones in and around an airport can significantly affect flight operations and pose risks to the surrounding area. To ensure the safety of the airport, it is essential to detect and report drones, and appropriate measures should be implemented to address potential accidents or incidents.

There is a need to define the specification of the C-UAS system components (detection, tracking, identification and counter measures):

- Come up with an operational process integrating the interoperability with other systems, actions and procedures.
- Better identify the neutralization component – not the mitigation countermeasure.
- Assessment of impact level to manage the air traffic.
- Identification of threat and different types of threat.
- Need to identify protocols, roles (of aviation security, airport operator, national authority, air navigation service provider, human operator, pilots (crewed and uncrewed aircraft), UTM service provider, law enforcement authorities, intelligence agencies and other national security entities, military, local authorities) and responsibilities.
- Response procedures using C-UAS technologies and Human machine interface (HMI).
- Recovery of airport operations.
- Reporting investigation and trend analysis.
- Data retention.

Research also addresses the development of drone intrusion management service to support and mitigate contingency and restoration actions in case of drone intrusions in the airport environment (or against other civil assets e.g., nuclear plants, sensitive data centres, etc.). The proposed solutions will increase situational awareness and eases the coordination and decision-making process between the key actors that have an active role in the actual management of the drone incursion or drone incident management cell (DIMC) as defined by EASA. Research shall consider the output of previous ASPRID project.

- **U-space advanced data exchange and communication service.**

  The primary objective is to investigate existing data requirements and develop innovative solutions to support a harmonised and interoperable U-space data exchange and communication service. The research shall cover the identification of necessary data and information to ensure the interoperability of current U-space services, as well as, the design of guidelines, communication protocols and data management strategies required to enable the full deployment of harmonised/interoperable U-space services.

  The following key areas should be addressed:

  - Data exchange mechanisms: validate data exchange protocols for real-time communication between operators, U-space service providers, CISP and traditional air traffic management (ATM) systems. Explore data exchange models to enhance scalability and robustness.

- Interoperability and standardization: identify existing data format standards, protocols and processes that can support interoperability between different U-space service providers and between U-space and traditional ATM systems.
- Standardization framework: consider datasets in the appendix of the regulation, propose updates or new data fields, standards, and protocols to ensure seamless interoperability and facilitate global adoption of U-space services. Identify risks and propose guidelines / methodologies to avoid misalignment and ensure full compatibility for data exchange.
- Automated data management: design automated systems for appropriate data collection, processing, storage, and dissemination to support real-time decision-making and situational awareness (per user type (e.g., USSP, CISP, drone operator, vertiport operators etc.)).
- Cybersecurity: Endpoints, data connection and ecosystem are cybersecure thanks to enhancement to key properties of information security such as, but not limited to, strong identification, authentication and integrity. Research shall consider the on-going work by ICAO on the international aviation trust framework (IATF), which aims at developing standards and harmonised procedures for a digitally seamless sky and dependable information exchange between all parties.

- **Infrastructure monitoring services**

  Research addresses the development of infrastructure monitoring services, including:

  - Navigation infrastructure monitoring service: the service is expected to provide up to date status information about navigation infrastructure. This service is intended to be used before and during operations. The service should give warnings of loss of navigation accuracy. Specifically, the GNSS service retrieves data from the EGNOS data access service (EDAS), from the Reference Stations database and, through the USSP API, from the U-Space Tracking and Monitoring service provided by the USSP. Once all the necessary data have been obtained, the service can provide GNSS signal monitoring, position velocity and time (PVT) and Integrity calculation. This service may also distribute correction information coming from augmentation services, and even real time kinematic (RTK) augmentation as appropriate.
  - Communication infrastructure monitoring service: the service is expected to provide up to date status information about communication infrastructure. This service is intended to be used before and during operations. The service should give warnings of degradation of communications infrastructure.

- **Mitigation of noise impacts of open and specific category drones**

  This element covers the development of a framework to assess the noise annoyance caused by small drones and propose and validate mitigation strategies, with a focus on mitigation strategies that may be applicable in the short term, e.g. establishing minimum flying altitudes or maximum speeds.

2.6.6.2 Topic HORIZON-SESAR-2025-DES-IR-02-WA6-2: Fast-track Extending U-space eco-system

Expected outcomes

To significantly advance the following development actions:

- IR-6-02 **CNS capabilities** for U-space, which includes detect and avoid and collision avoidance for UAS, and the use of mobile networks by U-space (including performance-based communication and surveillance services using a mobile network infrastructure).
- IR-6-03 **Extending U-space eco-system**. This includes the use of U-space services by commercial aircraft, general aviation, crewed VCA, etc., and the use of U-space services outside U-space airspace.

Scope (R&I needs)

The following list of R&I needs is proposed as an illustration of the potential project content, but it is not meant as prescriptive. Proposals may include other research elements beyond the proposed research elements below if they are justified by their contribution to achieve the expected outcomes of the topic and are fully aligned with the development priorities defined in the European ATM Master Plan.

- **Use of public LTE/4G/5G cellular networks for low altitude operations**

  Research addresses the potential use of public LTE/4G/5G networks for drones, GA and rotorcraft in various environments focusing on CNS applications – primarily enabled by TIS/FIS type of services and automatic vehicles' position reporting. The key operational benefit is increased traffic situation awareness of all stakeholders in the airspace today typically without or with very limited traffic surveillance.

  The research shall address:

  - The definition of operational use cases. These use cases should take into consideration operational use cases involving small drones in the open or specific categories, for fixed wing or rotorcraft GA, for certified crewed or uncrewed IAM vehicles, for ATC and/or for USSPs.
  - Development of onboard CNS equipment with integrated cellular network modem supporting deployed public cellular network. It includes additional CNS functions as required by local operating environment (e.g., U-space). Research shall define and validate performance requirements (e.g., low % of lost messages, latency, etc.).
  - Based on the coverage measurements/maps for different altitudes, it is expected that up to a defined altitude connectivity over public cellular network is reliable; multiple categories of reliability could be considered depending on the type of onboard equipment and the use case. The research should develop this taxonomy and investigate how they may be considered within SORA, e.g. to relax operational constraints when CNS capabilities are reliable.

- Development of the operational procedures applied to manage the potential degradation of service including the alerting mechanisms allowing to detect and share information about such degradation among all users.

- Assessment and demonstration of benefits resulting from the explored CNS enhancements for operational safety and for individual stakeholders (general aviation (GA) fixed wing or rotorcraft pilots, IAM pilots, remote pilots of drones and IAM, and ATC).

- Validate applications for GA, rotorcraft, and drones (e.g., traffic information, conformance monitoring & alerting, emergency management, etc.).

Research should investigate the potential for the newly developed technologies to be further developed in order to fulfil the performance required for their application to certified aircraft.

Research shall consider the work performed by solution PJ.14-02-05, which enabled GA pilots.

to receive updated FIS/TIS information during flight using LTE network, exploratory research FACT, which addressed the use of public LTE network for drones, GA and rotorcraft in various environments focusing on non-critical CNS applications and ER project NEWSENSE. Note that there is on-going work under project ANTENNAE.

- **Low-cost CNS solutions for vertiports (and regional airports)**

  This research element addresses the development of low-cost CNS solutions for vertiports. These solutions could be deployed also at regional airports that cannot afford the implementation of existing surveillance technologies such as MLAT and SMR because of their infrastructure costs. They represent a gap-filler solution that could also be used at larger airports to cover up current system limitations such as coverage issues and to extend ATS situational awareness in the apron and gate areas. The scope covers the potential application of:

  - mmWave radar as a new technology for the vertiports/airports surveillance. MmWave radar has been used for automotive and industrial applications but its use in the scope of airport/vertiport surveillance is new. MmWave radar assessment and machine learning applied to radar data obtained with measurements in airfield are completely new. Research shall consider the output of project NewSense.

  - 5G new radio (NR) as a new technology for airports. 5G signals has been previously used for other application areas (automotive, industrial, smart city), but their use in the scope of airport traffic management (e.g., positioning, line of sight detection, etc.) is new. An important advantage of being able to use the existing 5G networks for CNS objectives is the fact that no new infrastructure needs to be built and one could take advantage of already existing infrastructures. Research shall consider the output of project NewSense. Note that there is on-going work under project ANTENNAE.

  - Potential enhancements of ground infrastructure supporting augmentation of onboard navigation to increase its accuracy and resilience against GNSS degradation and supporting high integrity Autoland.

  - High-resolution video images as a "low cost" alternative means of surveillance for airports and vertiports.

These technologies are dual-use civil-military.

- **CNS capabilities for U-space, UAS and military integration**

  This covers the development of:

  - Navigation solutions based on 5G (or other means) for drone operations in urban areas.
  - Surveillance needs for drones. Drones are too small for primary surveillance, too low power to communicate position, and ADS-B is not a solution for them due to 1030/1090 congestion. Research shall propose potential solutions based on 5G (or other means) for surveillance purposes.
  - For drones research shall define the U-space requirements for communication infrastructure. While it is assumed U-space will have all needs covered, there may be limitations for their access to communication infrastructure / capabilities. This also covers the G/G communication between ATC and the drone operator (G/G), etc.
  - U-space GNSS: expansion of navigation infrastructure is essential to support the requirements of U-Space (e.g., related to weight and power consumption). This entails primarily utilizing GNSS sources capable of processing multiple constellations (e.g., DFMC ABAS or GBAS) and/or integrating SBAS or RTK augmentation.

  Research shall avoid duplication with on-going activities under the scope of European Defence Agency (EDA).

- **E-conspicuity solutions for U-space**

  Integration of other e-conspicuity solutions for U-Space, such as ADS-L over 866MHz (TACAN) or over Telecom networks. Coverage must extend to very low airspace volumes, as well as small targets with reduced radar cross section (RCS).

- **Integration of drones and crewed aircraft in defined shared airspace geozones**

  The DAR is based on the segregation of crewed aircraft and drones. The objective of the research is to develop a concept for a U-space service allowing the integrated operation of drones and crewed aircraft. This is expected to be of interest for example for the operation of rotorcraft and VCA in shared airspace with drones within a defined geographical zone. The research shall focus first on integration of drones with crewed VFR aircraft (which is considered to be the main use case) and may optionally address integration of drones with crewed IFR (provided applicable use cases are defined). The first use case for the application of this concept is emergency response, where the paradigm or rotorcraft flying above drones may not always apply. The concept may apply to additional use cases, e.g. ad-hoc surveillance operations (e.g., events).

  The research may build on previous work.[94] has explored the potential use of pre-departure deconfliction, whereby the drone and the VFR aircraft are each assigned areas of operation,

[94] Andreeva-Mori, A., Ohga, K., Kobayashi, K. Okuno, Y. Homola, J., Johnson, M., Kopardekar, P. (2021). Management of Operations under VFR in UTM for Disaster Response Missions. SESAR Innovation Days 2021.

concluding that the definition of meaningful areas of operation for VFR aircraft should be based on landmarks and on-board support for the VFR pilot would be useful in supporting adherence of the VFR aircraft to its assigned area of operation. The research should define the separation between the drone operating zones and the VFR operating zones, including definition of the applicable buffers. The concept may also address the introduction of flexibility for in-flight replanning of the VFR flights and/or the drones.

- **U-space services for certified (crewed or uncrewed) aircraft**

  The objective of this topic is to investigate the potential benefits of the use of U-space concepts by certified (crewed or uncrewed) aircraft. A first candidate service considered of interest for general aviation (GA), rotorcraft and GA is the U-space traffic information service. Indeed, general aviation (IFR or VFR) in uncontrolled airspace currently relies on see and avoid procedures to remain well clear from other aircraft, and could benefit from an increased situational awareness provided by an extended U-space U3 traffic information service providing traffic information. This would be like the TIS FIS service, but would provide information on all vehicles, including certified crewed or uncrewed aircraft and small open or specific category drones flying in the area. The service would integrate traffic information from different sources, i.e. U-space tracking, cooperative surveillance, uncooperative surveillance.

  Proposals may address U-space services other than the traffic information service; in such case, the proposal should provide a description of the U-space service and briefly described how it would be used by certified aircraft and what the expected benefits are.

2.6.6.3 Topic HORIZON-SESAR-2025-DES-IR-02-WA6-3: Fast-track Enabling innovative air mobility (IAM) / Vertical take-off and landing capable aircraft (VCA) (crewed and uncrewed) operations

Expected outcomes

To significantly advance the following development actions:

- IR-6-04 **Enabling IAM/VTOL capable aircraft** (crewed and uncrewed) **operations,** including in complex environments, congested areas and vertiports. This includes IAM operational procedures enabling access to all types of airspace and vertiports (both VMC and IMC) and IAM automation including simplified vehicle operations, automatic take-off and landing (TOL), resilient navigation, energy management, etc.

Research shall take into consideration the work done under EASA[95] on this element, especially in relation to General Aviation i-conspicuity needs.

Scope (R&I needs)

The following list of R&I needs is proposed as an illustration of the potential project content, but it is not meant as prescriptive. Proposals may include other research elements beyond the proposed

[95] https://www.easa.europa.eu/en/research-projects/i-conspicuity-interoperability-electronic-conspicuity-systems-general-aviation

research elements below if they are justified by their contribution to achieve the expected outcomes of the topic and are fully aligned with the development priorities defined in the European ATM Master Plan.

- **Vertiport management for crewed VCA**

  EC IR 2014/1111[96] established the requirements for operations of crewed VCA, with specific requirements for the specification in the operational flight plan of at least two safe landing options at the destination, as well as adequate vertiports, diversion locations for VTOL aircraft (carrying out flights for medical missions in urban areas) (VEMs) operating sites that are available and permit a landing to be executed in a critical failure for performance (CFP). The research must establish how to fulfil this requirement from the ATS perspective, addressing:

  - If the landing sites should be introduced in the ATS flight plan (the regulation currently leaves this point open) and if so, how this would be done for both VFR aircraft and IFR aircraft. Note for IFR crewed VCA, the landing sites should be included in the FF-ICE flight plan and coordination is needed with the WA1 or WA3 projects working in this area).

  - Design and validate process to book all landing sites from departure to destination and progressively release contingency sites as the flight progresses and investigate how this process will be integrated with ATM processes. Research should investigate if for VFR aircraft the booking of the landing sites should be linked to a new VFR flight plan acceptance process, to an ATC clearance to land at the destination and all the landing sites given at the time of take-off, to a FIS-like service declaring all sites are available is sufficient to cover the requirement, or a different U-space service needs to be defined. The legal liability in case the landing site is not available when the VCA arrives must be investigated.

  The research must address the following cases:

  - The destination is in a controlled airport that is not in U-space airspace. In this case, the research could develop an ATC reasonable assurance principle to allow the use of one or both landing spots planned in a VTOL capable aircraft (VCA) flight plan even after the VCA is already en-route. The adaptation of the conflicting ATC clearances safety net to support the concept could be investigated.

  - The destination vertiport is in U-space airspace that is in controlled airspace. Note in this case the DAR principle in U-space regulation[97] applies, so that the airspace will be clear of drones and managed as controlled airspace during the conduct of the crewed VCA flight. The research may propose alternative airspace sharing concepts beyond what is possible within the current regulation.

  The research must aim at delivering a TRL6 solution aimed at enabling the deployment of crewed VFR VCA and Progress towards a future solution applicable to crewed IFR VCA, for which an FF-ICE flight plan acceptance process must be defined and validated (for this point, coordination with relevant projects in WA1 and WA3 is required).

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[96] https://eur-lex.europa.eu/eli/reg_impl/2024/1111/oj

[97] European Commission Implementing Rules EU IR 2021/664 and EU IR/665.

This element covers vertiport management for vertiports located in controlled airspace (class A-D) – which could also be in U-space airspace - and vertiports located in uncontrolled airspace (class F and G) that is not also declared as U-space airspace. Vertiports located in uncontrolled airspace that is also U-space airspace are covered in the element below (in this same WA).

Note that there is on-going work under project EUREKA.

- **Advanced vertiport and VCA U-space services**

  This element covers vertiport management functions and activities that impact traffic management for vertiports located in U-space airspace, bearing in mind the constraints imposed by battery powered aircraft. This may include:

  - Processes that determine or limit take off time.
  - Processes that determine or limit landing time.
  - Processes governing occupancy of critical resources such as the touchdown and lift-off area (TLOF).

  These processes should be identified, and consideration given to their optimisation in the context of U-space including collaborative decision making and coordination as appropriate. Note that there is on-going work under project EUREKA.

  This topic covers vertiport management for vertiports in uncontrolled airspace (airspace F and G) that is also declared to be U-space airspace (expected to have significant traffic of small drones); the focus of the research is to ensure separation between small drones and VCA vertiport users. Vertiports that are not located under U-space airspace or that are located in U-space airspace in controlled airspace are covered by the element above (in this same WA).

  Initially, the scope is focused on crewed VCA operations, but it is expected that the same concepts will be applicable for uncrewed VCA.

- **Crewed IFR VCA**

  The aim of the research is to develop the concept for IFR crewed VCA, building on existing SESAR solutions for IFR helicopters “Optimised low-level IFR routes for rotorcraft” (SESAR solution #113) and “Independent rotorcraft operations at airports” (SESAR solution PJ.02-05). The solution should assess the applicability of existing IFR rotorcraft procedures and flight planning processes to VCA, adapting them where necessary.

  In particular, the research must assess how VCA energy management constraints may affect the capability of VCA aircraft to follow the type of IFR clearances in use for helicopters and develop and validate their use for VCA, proposing and validating new clearances where needed.

  Note the flight planning aspects related to the introduction of the landing sites in the FF-ICE flight plan should are linked to vertiport management and hence in scope of the previous bullet point “Vertiport management for crewed VCA”.

- **Automation of the VCA cockpit and remote pilot’s working position**

The objective of this element is to address pilot digital assistance and automation support for the VCA cockpit to support a simplified VCA workload (e.g., aimed at a reduction of VCA crew workload related to pilot's tasks and tasks related to communication with ATM, implementation of tactical ATC clearances, and on-board implementation of strategic changes to the flight plan in the execution phase for IFR VCA (after an FF-ICE/R2 revision process). The scope includes in particular the development of cockpit automation to support a concept for digital ATM communications via CPDLC during all phases of flight (en-route, TMA and airport).

The ultimate objective is to make it possible that the flight crew workload is reduced to support the concept of one remote pilot overseeing from its working position two or more VCAs.

Note that there is on-going work on this research element under project OPERA.

- **Automatic take-off and landing (ATOL) for crewed or uncrewed VCA and helicopters**

  The scope includes the development of navigation and procedures to enable all -weather take-off and landing for crewed or uncrewed VCA. Resilience of the navigation solution must be addressed. The solution is expected to progress from an initial flight-director-based concept towards the end goal of autopilot-based ATOL. Charts, procedure design and avionics should be addressed. Note that similarly to what happens today with Autoland for fixed-wing aircraft today, air traffic aspects e.g. clearance for approach, take-off and landing are not different in ATOL from vs. manual TOL (just like whether Autoland is used does not change the way ATM currently manages a flight), and hence do not need to be covered by this solution.

  Note that there is on-going work on this research element under project OPERA.

- **ATC and flight information service (FIS) automation support**

  VCA will first be certified as VFR, to later progress to IFR. The objective of the research is to increase the level of automation of VFR aircraft by ATC and FIS. Flight data processing systems (FDPSs) are designed for supporting ATC in the management of IFR aircraft, and typically do not provide adequate functionality to support ATC for the management of VFR aircraft. This results in VFR flights often causing unexpected ATS workload in the lower airspace. Research shall develop ATS automation tools and procedures to provide ATC or FIS services to VFR aircraft in airspace C-G and FIS services to IFR aircraft in uncontrolled airspace (airspace F and G). Research shall aim, as much as possible, at developing tools and concepts that can be applicable to both ATC (TWR or En-Route/TMA) and AFIS. The tools and procedures to be applicable will be applicable for all equipped VFR aircraft (not just VCA):

  - Development of a new FF-ICE-like flight plan standard for VFR aircraft.
  - Improve ATC ground systems for handling VFR flights and for supporting the transition IFR to VFR and VFR to IFR.
  - One of the difficulties for the management of VFR aircraft is that they are not subject to the same ATC clearance requirements, and they do not have to adhere to their flight plan like IFR aircraft. The research may investigate how to reduce the uncertainty on VFR flights (e.g., by using new methods based on artificial intelligence/machine learning to better forecast VFR traffic).

- The research may investigate methods allowing VFR aircraft to share their intended route with ATC (e.g., via the downlink of the planned trajectory from an EFB using the applicable air/ground SWIM standard).
- Automation support for the provision of traffic information, potentially including fully automated provision of routine traffic information via VHF by a digital voice.
- The research should investigate the applicable safe wake turbulence separation from other traffic (for VCA), on approach and departure, beyond the initial requirement from EASA Prototype Specification, and in particular the ability to sustain possible encounter with wake vortices, generated by other aircraft or (large) rotorcraft. VCA (as multi-rotor vehicles) might have the same controllability / control authority (crewed or uncrewed) as other rotorcraft or as fixed wing aircraft, and this should be further studied and understood, based on state-of-the-art wake turbulence characterisation capabilities and risk assessment methodologies, in order to assess the need for applicability of standard or specific wake turbulence separation or management requirements.

This research will pave the way for the introduction of digital flight rules, which is currently in scope of exploratory research.

2.6.7 Work Area 7: Transversal activities

SESAR 3 JU is the responsible for the execution and maintenance of the European ATM Master Plan. Also, although the responsibility for conducting individual performance assessments and CBAs lies with the SESAR 3 R&I projects, there is a need for the SESAR 3 JU to engage in a continuous process of performance evaluation to ensure that it is moving towards the performance benefits specified in the European ATM Master Plan. The transversal activities aim at supporting S3JU and the R&I programme on these two areas.

Specific conditions for WA7	
Indicative budget	The total indicative budget for this work area is EUR 3.00 million
Type of actions	Coordination and support action (CSA)
Other requirements	The maximum project duration is 36 months.

2.6.7.1 Topic HORIZON-SESAR-2025-DES-IR-02-WA7-1: Support to programme execution framework on performance

Specific conditions for WA7-1	
Expected EU contribution per project	The SESAR 3 JU estimates that a maximum EU contribution of EUR 2.00 million would allow the outcomes to be achieved. Nonetheless, this does not preclude the submission or the selection of a proposal requesting a different amount.
Indicative budget	The total indicative budget for this topic is EUR 2.00 million

Expected outcomes

The proposals will contribute to the following expected outcomes in support of the SESAR 3 JU:

- Consolidation and agreement on expected performance contributions (EPC) across the SESAR programme.
- Provision of a yearly consolidated view of the performance impact of future ATM concepts and SESAR solutions at ECAC network level, bringing together individual SESAR solution performance benefits and integrated network performance of all available SESAR solutions.

Scope (R&I needs)

The scope covers the support to SESAR performance related activities. architecture activities (i.e., architecture modelling framework and support) and performance activities.

Regarding the performance dimension, the SESAR performance management process steers the overall R&I work, with reference to the SESAR performance ambitions and associated benefits specified in the European ATM Master Plan. It is based on the application of the baselined SESAR performance framework (SPF)[98]. The SESAR performance management process reconciles and maps the performance assessments and results delivered by the R&I projects with the SESAR Master Plan performance ambitions. It also ensures aggregating these results through the simulation of the relevant SESAR Solutions with the objective of delivering an ECAC-wide performance view, consolidation of performance results of on-going development activities, etc.). To achieve the expected outcomes, the activities to be performed under the leadership of the SESAR 3 JU will focus on the following areas:

- Maintenance of performance framework:
  - Maintain reference performance methodologies (human performance assessment methodology, security assessment methodology and the security reference materials, environmental impact assessment methodology, safety assessment methodology, etc.) and performance framework (e.g., U-space performance framework, digitalisation, automation levels, passenger experience, etc.) following e.g., the update of the ATM Master Plan, Single European Sky (SES) reference period (RP), needs expressed by SESAR solutions or observed during the execution of R&I activities, etc. (upon the explicit request of the SESAR 3 JU).
  - Review and consolidation of SESAR templates and assessment criteria (either for deliverable assessment and/or for maturity gate).
  - If required, support and coach R&I project staff to ensure the correct application of the performance methodologies (e.g., safety, human performance, (cyber)security, environment) and the performance framework.

[98] Baselined SESAR performance framework is always aligned to the ATM Master Plan in execution in the programme.

- Support, as the performance expert(s) point of contact, within each SESAR JU programme management team in particular through monitoring and consolidation of each SESAR Solution performance workflow stage(s), in preparation for robust validation plans and validation reports.
- At the request of the SESAR 3 JU, contribute to solutions maturity gates to confirm that a robust performance approach based on the methodology has been applied by the projects.

- Support to performance assessment and consolidation of network impact assessment:
  - Monitor proper implementation of SESAR performance workflow, from stage 1 in consolidation and agreement on expected performance contributions (EPC) up to stage 4 on performance result consolidation including extrapolation at ECAC level.
  - Capture and aggregate the performance assessments delivered (for completed SESAR solutions) and the expected performance contributions (for SESAR solutions in progress) by R&I projects, delivering a yearly programme performance report in support to the yearly ATM Master Plan strategic development monitoring report, and a final PAGAR (i.e. full PAGAR campaign) at the end of the action.
  - Network impact assessment: run integrated simulation on multiple SESAR Solutions, for consolidating a yearly programme performance report, assess trade-offs between key performance areas (KPAs) / key performance indicators (KPIs).
  - Support to SESAR 3 JU on monitoring the progress of the R&I programme on environmental sustainability, digitalisation, etc.

2.6.7.2 Topic HORIZON-SESAR-2025-DES-IR-02-WA7-2: Support to programme execution on SESAR architecture and on Strategic deployment planning and monitoring

Specific conditions for WA7-2	
Expected EU contribution per project	The SESAR 3 JU estimates that a maximum EU contribution of EUR 1.00 million would allow the outcomes to be achieved. Nonetheless, this does not preclude the submission or the selection of a proposal requesting a different amount.
Indicative budget	The total indicative budget for this topic is EUR 1.00 million

Expected outcomes

The proposals will contribute to the following expected outcomes in support of the SESAR 3 JU:

- Consistent SESAR architecture design (including when necessary, modelling) across the programme.
- Future Common Project regulations support the deployment of those strategic deployment objectives (SDO) elements that require a synchronised and harmonised roll-out at European level.

- Involvement of ATM workforce through their professional staff in the deployment planning activities, training, and engagement to gain social acceptance of the changes envisaged by the SDOs.

- Focus should be paid on facilitating the market deployment of priorities (i.e., SDOs) by a critical mass of early movers.

- In doing that, the project should support the SESAR 3 JU in the coordination at technical level of all entities involved in deployment at European level (e.g., EASA, SDM, EUROCAE, EDA, CNS Programme and Network Managers):

    - Supporting S3JU in securing that Governing Board members are well informed at strategic level about the status of prioritised deployment activities defined in the European ATM Master Plan.

    - The European Plan for Aviation Safety (EPAS) of European Union Aviation Safety Agency (EASA) and its supporting standardisation framework is fully aligned with priorities and timelines of the Master Plan.

    - SES instruments work hand-in-hand (as from RP4) to promote investments on SDOs.

    - ATM functionalities within the scope of SDOs requiring global harmonisation are recognised in the ICAO Global Air Navigation Plan (GANP) as priorities for global harmonisation fostering the necessary adaptation of the global regulatory framework.

Scope (R&I needs)

The scope covers deployment activities on the ATM Master Plan and the support to SESAR architecture activities (i.e., architecture modelling framework and support).

Regarding the support to SESAR 3 JU in the management of the SESAR architecture (e.g., common taxonomy maintenance, content integration analysis, etc.), the scope covers the following activities:

- Upon the explicit request of the SESAR 3 JU, maintain architecture modelling methodology and framework and extend it if justified by programme needs (e.g., supporting the cyber risk assessment of supporting assets).

- Monitor SESAR architecture modelling, consistency / coherency analysis of architectural information, etc., applying the methodology defined and agreed during DES IR1 call activities under project AMPLE-3, and documented in the SESAR project handbook.

- Monitor and report SESAR architecture progress at programme level, as the architecture modelling point of contact, within each SESAR 3 JU programme management team through monitoring and consolidation of each SESAR Solution architecture.

- Support to SESAR 3 JU on monitoring the progress of the R&I programme on key dimensions of the ATM Master Plan such as trajectory based operations (TBO), dynamic airspace configuration levels, automation levels, etc.

- (At the request of the SESAR 3 JU), contribute to maturity gates (as prioritised by SESAR 3 JU) to confirm that performance benefits and architecture progress are not only robust enough, but also aligned to the ATM Master Plan vision (i.e., performance ambitions and benefits, new service delivery model and target architecture), etc.).

On the deployment dimension, this includes supporting the SESAR 3 JU to report on deployment activities in both industrialisation and implementation. To achieve the expected outcomes, the activities to be performed under the leadership of the SESAR 3 JU will focus on the following areas:

- Main activities:
    - Support the SESAR 3 JU for the elaboration of the annual strategic deployment monitoring report, covering both voluntary deployment (e.g., by early movers associated to SDOs) and mandatory (e.g., regulated by Common Project CP1) deployment activities in both industrialisation (i.e., standardisation and regulation/certification) and implementation. This report should also establish a clear link and capture synergies with the implementation of the performance scheme and the mechanisms in place to monitor related investments (e.g., Performance Review Body (PRB) annual reports).
    - Encourage market uptake of SESAR Solutions throughout the European network, provide support in updating the SESAR Solutions catalogue and the SESAR 3 JU website, regarding links to deployment, as a communications and dissemination tool.
    - Support market uptake through deployment guidance (e.g., focusing on the human dimension of SDOs, etc.). Support on CBA activities in support of market uptake (e.g., keeping consolidated SDOs CBAs updated and deep-dive on some deployment actions when necessary to support market uptake) developing the required material for supporting decision makers. This may include network impact assessment activities, running integrated simulation on multiple SESAR Solutions, duly replicating observed real world operational environments to assess the impact that they could have at network level.
    - Support SESAR 3 JU in maintaining the links between standardisation and regulatory needs (and corresponding enablers) and the European ATM standards coordination group (EASCG) and the European UAS standards coordination group (EUSCG) rolling plans.
- Additional support activities (on the request of the SESAR 3 JU):
    - Support (at the request of the SESAR 3 JU) other ad hoc strategic planning and monitoring activities (e.g., airspace architecture study-type activities, definition of future common project proposals where and when mandated, update of SRIA, etc.).
    - Support the alignment of the ICAO aviation system block upgrade with the evolution of the European ATM Master Plan.
    - Support preparation for performance impact plans on future reference periods (at national and ECAC levels).
    - Support to a potential ATM Mater Plan update campaign.

Appendix A: Coverage of ATM Master Plan Exploratory Research development priorities

This appendix includes the mapping between the development priorities (DP) for exploratory research and the R&I flagships identified in the Strategic Research and Innovation Agenda (SRIA).[99]. The table also shows the coverage of these development priorities by the Working Areas (WA) under ER3 call specifications.

Development priority ID	Development Priority name	SRIA flagship	Coverage by ER-03 Call specifications
Exploratory research			
AR-1	Research to help shape the future regulatory framework for a Digital European Sky	Connected and automated ATM AI for Aviation	WA-2
AR-2	Definition of advanced U4 U-space services	U-space and urban air mobility	Not covered
AR-3	Integration of the next generation aircraft for zero/low emission aviation	Air-ground integrations and autonomy Aviation Green Deal	WA-2
FR-1	ATM impact on climate change	Aviation Green Deal	WA-1
FR-2	Digital Flight Rules	Connected and automated ATM	WA-1
FR-3	Investigate quantum sensing and computing applied to ATM	Connected and automated ATM	WA-1

Table A6: ER development priorities coverage by ER-03 call

Appendix B: Coverage of ATM Master Plan Industrial Research development priorities

This appendix presents the mapping between the development priorities (DP) (and development actions (DA)) and the R&I flagships identified in the Strategic Research and Innovation Agenda (SRIA).[100]. The table also shows the coverage of these development priorities by the Working Areas (WA) under IR2 call specifications.

Development priority / Development action ID	Development priority / Development action name	SRIA flagship	Coverage by IR2 Call specifications
Industrial research			
IR-1	**Transformation to trajectory-based operations**		
IR-1-01	Integrated air/ground trajectory management based on ATS-B2 including the extension for lower airspace and airport surface.	Air-ground integration and autonomy Connected and automated ATM	WA3, WA4

[99] SESAR Joint Undertaking | SRIA (sesarju.eu)

[100] SESAR Joint Undertaking | SRIA (sesarju.eu)

IR-1-02	Development of FF-ICE, including FF-ICE pre-departure enhancement and FF-ICE/R2	Connected and automated ATM	WA1
IR-1-03	Advanced network trajectory synchronisation in the execution phase	Connected and automated ATM	WA1
IR-1-04	Connected and integrated flight management system (FMS), electronic flight bag (EFB) and flight operations centre (FOC) functionalities for trajectory optimisation	Air-ground integration and autonomy	WA1
IR-1-05	Dynamic route availability document (RAD) towards a RAD by exception environment	Connected and automated ATM	WA1
IR-2	**Transition towards high performance of air-ground connectivity (multilink)**		
IR-2-01	Complete development of successor(s) of VHF data link mode 2 (VDL2) (L-band digital aeronautical communications system (LDACS), hyper-connected ATM, satellite communications (SatCom class A), covering civil military dual use.	Connected and automated ATM Civil/military interoperability and coordination	WA2
IR-2-02	Aircraft as a sensor, including transmission of humidity information to ground, etc.	Air-ground integration and autonomy	WA2
IR-3	**Future en-route and TMA ground platforms**		
IR-3-01	Addresses the next generation ATC platform, fully leveraging aircraft capabilities. This includes supporting a data-sharing service delivery model, resilient integrated CNS/MET as a service, traffic synchronisation, etc., accommodating the specific needs of the military, innovative air mobility (IAM), higher airspace operations (HAO), and U-space, etc.	Connected and automated ATM Virtualisation and cyber-secure data sharing AI for Aviation	WA3
IR-3-02	Artificial intelligence (AI) capabilities enabling the next generation platforms.	AI for Aviation	WA3
IR-3-03	Cyber-resilience and cyber-security capabilities enabling the next generation platforms.	Virtualisation and cyber-secure data sharing Civil/military interoperability and coordination	WA3
IR-3-04	Separation management for high levels of automation.	Connected and automated ATM	WA3
IR-3-05	Demand capacity balancing (DCB) and airspace configuration concepts for high levels of automation.	Capacity on-demand and dynamic airspace Civil/military interoperability and coordination	WA3
IR-3-06	Future human–machine teaming.	Connected and automated ATM Capacity on-demand and dynamic airspace AI for Aviation	WA3
IR-3-07	Ground capabilities for reducing ATM environmental footprint. This includes climate-optimised trajectories including non-CO_2 effects (e.g. contrails), environmentally optimised climb and descent operation, advanced required navigation performance green	Connected and automated ATM Aviation Green Deal	WA3

	approaches, dynamic allocation of arrival and departure routes considering noise and local air quality, green ATC capacity concept, flexible eco-friendly clearances, wake energy retrieval (WER)[101], integration of sustainable aviation fuel (SAF) and zero emissions aircraft, environmental performance dashboards, etc.		
IR-3-08	Geometric altimetry	Connected and automated ATM	WA5
IR-3-09	CNS capabilities to increase ATM system robustness (e.g. satellite-based multilateration (MLAT)), GBAS dual frequency/multi constellation leveraging Galileo and providing robust protection against jamming and spoofing).	Connected and automated ATM	WA3
IR-4	**Future airport platform**		
IR-4-01	Addresses the next generation airport platform fully leveraging aircraft capabilities. This includes supporting the data-sharing service delivery model, interconnected with other airports and their 3rd parties (e.g. ground handlers), ANSPs, NM, CNS/MET as a service, etc., facilitating the accommodation of IAM, the interface with U-space as well as specific needs from the military.	Connected and automated ATM Virtualisation and cyber-secure data sharing	WA4
IR-4-02	AI capabilities enabling the next generation of airport platforms.	AI for aviation	WA4
IR-4-03	Cyber-resilience and cyber-security capabilities enabling the next generation of airport platforms.	Virtualisation and cyber-secure data sharing Civil/military interoperability and coordination	WA4
IR-4-04	Airport solutions for reducing environmental impact of operations. This includes green-taxiing related concepts, environmental performance dashboards, etc.	Connected and automated ATM Aviation green deal	WA4
IR-4-05	Future human–machine teaming.	Connected and automated ATM Capacity on-demand and dynamic airspace AI for Aviation	WA4
IR-4-06	Optimisation of runway throughput.	Connected and automated ATM	WA4
IR-4-07	Smart airports, airports as multimodal nodes and passenger experience.	Multimodality and passenger experience	WA4
IR-5	**Autonomy and digital assistants for the flight deck**		
IR-5-01	Single pilot operations (SiPO). This includes new sensors and aircraft architectures for the evolution towards SiPO/highly automated operations.	Air-ground integration and autonomy	WA5

[101] In order to avoid content duplication, wake retrieval energy (WER) description is provided in the topic WA5-3, which is addressing the development action IR-5-04.

IR-5-02	Increased automation assistance for the pilot for ATM tasks. This includes improved flightdeck HMI and procedures for CPDLC, voice-less technology, etc.	Air-ground integration and autonomy AI for aviation	WA5
IR-5-03	Highly automated ATM for all airspace users. This includes required performance-based CNS enablers (assured navigation for robust ATM/CNS environment for all phases of flight, alternative position, navigation and timing (A-PNT) providing enhanced robustness against jamming and spoofing, leveraging Galileo, electronic conspicuity, sense and avoid, enhanced distance measuring equipment (eDME), etc.), to facilitate the integration of advanced airborne automation and future ATC platforms, as well as accommodating IAM and interfacing with U-space.	Air-ground integration and autonomy	WA5
IR-5-04	Airborne capabilities for reducing ATM's environmental footprint. This includes wake energy retrieval (WER), energy-based operations, environment-driven trajectory optimisation, etc.	Air-ground integration and autonomy Aviation Green Deal	WA5
IR-6	**U3 U-space advanced services, IAM and vertiports**		
IR-6-01	U3 U-space advanced services addressing aspects such as common altitude reference, collaborative interface with ATC, tactical conflict detection and resolution, fairness in strategic deconfliction, etc.	U-space and urban air mobility	WA6
IR-6-02	CNS capabilities for U-space, which includes detect and avoid and collision avoidance for UAS, and the use of mobile networks by Uspace (including performance-based communication and surveillance services using a mobile network infrastructure).	U-space and urban air mobility	WA6
IR-6-03	Extending the U-space ecosystem. This includes the use of U-space services by commercial aircraft, general aviation, crewed VCA, etc., and the use of U-space services outside U-space airspace.	U-space and urban air mobility	WA6
IR-6-04	Enabling IAM/VCA (crewed and uncrewed) operations, including in complex environments, congested areas and vertiports. This includes IAM operational procedures enabling access to all types of airspace and vertiports (both VMC and IMC) and IAM automation including simplified vehicle operations, automatic take-off and landing (TOL), resilient navigation, energy management, etc.	U-space and urban air mobility	WA6

Table A2: Coverage of IR development priorities and development actions by IR2 call

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