Open VLD 2 call

Technical Specifications

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Abstract

This document defines the Technical Specifications for the SESAR Open VLD 2 Call (H2020-SESAR-2020-1).

Founding Members

EUROPEAN UNION EUROCONTROL

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1 Introduction

1.1 Purpose of the Document

This document constitutes the Technical Specifications for the SESAR 2020 Open VLD2 Call H2020-SESAR-2020-1). It includes the description of all topic planned to be awarded under this call and complements the information that can be found in the Single Programming Document 2020-2022

1.2 SESAR programme objectives and scope

The SESAR programme aims to ensure the modernisation of the European air traffic management (ATM) system by coordinating and concentrating all relevant research and development efforts in the European Union on ATM.

The SJU is responsible for the execution of the European ATM Master Plan and in particular for carrying out the following tasks:

- Organising and coordinating the activities of the development phase of the SESAR project in accordance with the European ATM Master Plan, by combining and managing under a single structure public and private sector funding;
- Ensuring the necessary funding for the activities of the development phase of the SESAR project in accordance with the European ATM Master Plan;
- Ensuring the involvement of civil and military stakeholders of the air traffic management sector in Europe and in particular; air navigation service providers, airspace users, professional staff associations, airports, the manufacturing industry and relevant scientific institutions and members of the scientific community;
- Organising relevant research and development to be carried out under its authority;
- Ensuring the supervision of activities related to the development of common products identified in the European ATM Master Plan, either through grants to members or other appropriate mechanisms following proposals to achieve specific programme objectives (in accordance with Regulation 1271/2013).

1.3 The SESAR innovation pipeline

The second SESAR R&I programme (SESAR 2020 Programme) is structured in three main R & I phases that aim to deliver a pipeline of innovation, which matures operational and technology solutions through the European Operational Concept Validation Methodology (E-OCVM), a well-established control and monitoring process linked to the technology readiness level (TRL).

This pipeline starts with the EU Aviation Strategy and the SES objectives that feed into the European ATM Master Plan, the main planning tool defining the ATM modernisation ambition, roadmap and priorities. This document is maintained and updated on a regular basis with wide stakeholder consultation and includes the results of SESAR research activities. Exploratory Research (ER) addresses both transversal topics for future ATM evolution and application-oriented research.

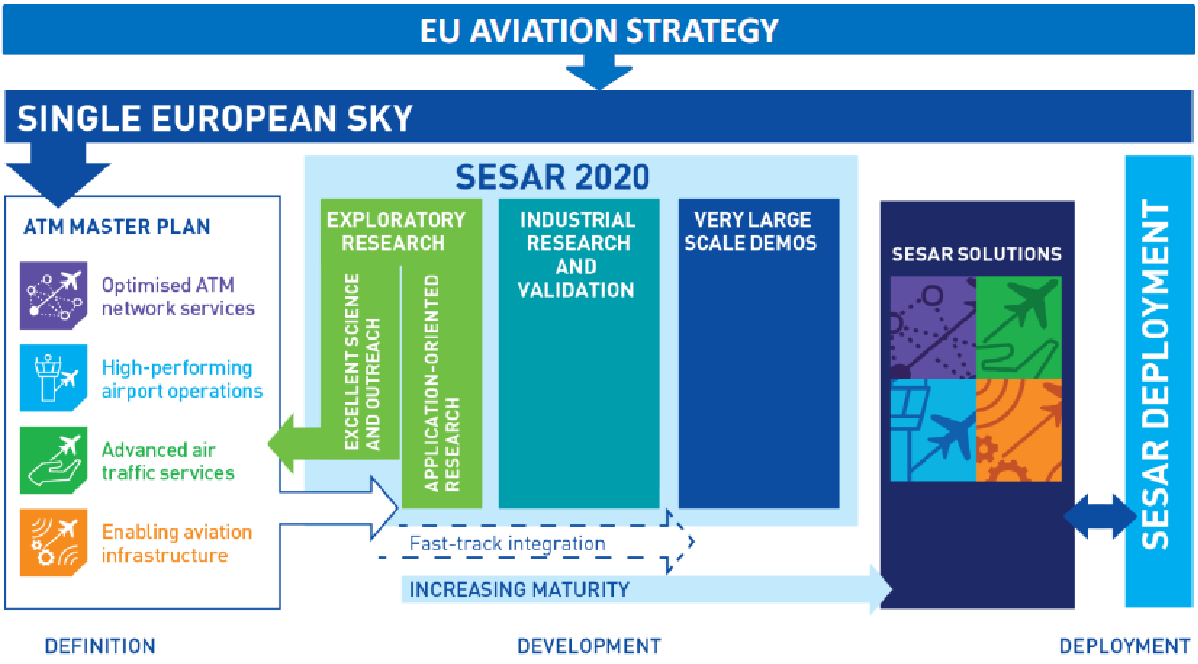

Figure 1: SESAR's innovation pipeline – from the EU Aviation Strategy to SESAR Solutions [1]

According to the four Key Features defined in the Master Plan (Version 2015), it is then expanded with contributions from the SESAR JU Members that undertake Industrial Research and Validation (IR). As per the European ATM Master Plan, this will ultimately deliver results in the form of SESAR Solutions that will contribute to firmly establishing the performance benefits in preparation for deployment. The SESAR JU then further exploits the benefits of the partnership in demonstrating on a large scale the concepts and technologies in representative environments (VLD for Very Large-Scale Demonstration activities). In some cases, for instance where an iterative development model is appropriate or where technology is mature in sectors other than ATM, fast-track integration from Application-Oriented Research to Demonstration activities is also possible.

Not all research can be progressed at the same pace, nor is it beginning from the same level of understanding or will it deliver to the same expectation. Consequently, the key features, above, remain a persistent target, aligned with Single European Sky (SES) while the actual research is matured over time and in accordance with research and industry best practice.

1.4 SESAR Very Large Scale Demonstrations (VLD)

The role of Very Large-Scale Demonstrations (VLDs) is to bridge the Research & Innovation with implementation, and not to replace either type of activity. VLDs use early versions of end-user systems and include the integration of new technology elements into existing systems when needed and when possible. In many cases, Airspace Users and/or other key stakeholder participation to VLDs is essential to achieve the goals of the demonstrations and secure stakeholder commitment to operational roll-out.

As Very Large-Scale Demonstrations are primarily designed to help bridge the gap between the development and operational implementation, they are at the border in terms of maturity transition from the Industrial Research & Validation and the industrialisation and to the subsequent implementation. As such, they will mostly derive from work matured through an earlier phase of Industrial Research & Validation while taking the opportunity to trial innovation close to the market to help secure a short time to market.

The VLDs described in this Technical Specifications are not being established to complement the VLDs in the IR-VLD Wave 2 or 3 call. The VLDs described here may also be a vehicle to promote SESAR Solutions outside Europe and contribute to global de-carbonisation/fuel efficiency.

1.5 Work Breakdown Structure of the Call

The Demonstration activities within this call for proposals were defined using the priorities set out in the European ATM Master Plan[1] and in particular the Essential Operational Changes. The latter have been significantly consulted on during the ATM Master Plan update campaign at Master Planning Committee level but also as part of the formal consultation phase initiated at SESAR JU Administrative Board level.

The call content is structured in a number of topics that contribute to at least one of the following key focus areas derived from the European ATM Master Plan:

- Airspace optimisation: initialisation of the ‘Digital European Sky demonstrators’ as defined in the Airspace Architecture Study Transition Plan[2] (topics 1 and 2),
- Safe integration of drones: demonstration of U-space capabilities and services to enable Urban Air Mobility (topic 3),
- Environment: demonstrating ATM operations mitigating aviation’s environmental footprint and significantly contributing to the reduction of CO_2 emissions (topic 4).

Proposals for demonstrations received as a result of this call shall build upon the SESAR results that are publicly available through the SESAR Joint Undertaking and CORDIS[3] websites (including but not limited to the European ATM Master Plan, the Airspace Architecture Study and the SESAR Solution descriptions). These shall show a significant contribution towards bridging the gap between development and operational roll-out.

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[1] ATM Master Plan : https://www.sesarju.eu/node/3469

[2] The transition plan identifies key measures that need to be implemented in the very short term (2020 to 2025) in order to set in motion the transformation changes outlined in the Airspace Architecture Study. https://ec.europa.eu/transport/sites/transport/files/2019-09-high-level-conference-future-of-ses-aas-transition-plan.pdf

[3] CORDIS is the Community Research and Information Service of the European Commission, providing information on all EU-funded research projects https://cordis.europa.eu/projects/en

2 Topic 1: Optimised use of Airspace

2.1 Specific Challenge:

Air Traffic is not a constant stream of flights over space and time. There is a continuous variation in traffic density and complexity. Due to historic limitations, ATM has so far worked with a semi-static way of sub-dividing the airspace in sectors. Traditionally this partitioning is managed at individual state level within its boundaries, leading to inefficient configurations since state boundaries bare no relation with optimum air traffic flows.

With more and more traffic to be handled in a cost–efficient way and in trajectory Based operations, there is a need to evolve to a truly flexible organisation and management of airspace structures, just like all resources of the ATM network. Sectorisation should be fully optimised in function of the foreseen traffic demand (including military airspace needs of all these states) and irrespective of their national boundaries (large-scale cross border Free Route Airspace). For integrating trajectory-based operations, airspace structures shall react accordingly to a dynamic situation, where free routing principles are more compatible. Civil-military coordination is to be more efficient using interoperable tools to manage ad-hoc airspace structures in shape and time dimensions.

A first step to address the challenge is to support the AAS TP MEASURE 1 "Launch an airspace re-configuration programme supported by an operational excellence programme to achieve quick wins" and demonstrate the benefits.

Considering traffic hotspots identified in the Airspace Architecture Study Transition Plan , the VLD therefore aims at demonstrating an optimised and coordinated organisation of airspace activations and reservations, able to support optimised traffic flows in a free route environment as well as other uses of airspace (e.g. military). In essence, the main change is to move from airspace management (ASM) collaborative processes to ASM reconciled with ATC and ATFCM into a fully integrated ASM, ATC, ATFCM and CDM layered process, resulting in fully dynamic airspace configurations (i.e. higher level of modularity and flexibility up to the execution phase), supported by automated tools and, it is as well, an enabler of integrated capacity management processes. The dynamic airspace also requires the development of new ATS working methods supported by automation and new tools.

2.2 Scope:

The demonstration activities under this topic aim at the identification and demonstration of operational improvements in support of the operational excellence programme described in the AAS TP:

- "Best-in-class" operations that would help delivering a minimum set of common operational capabilities among all stakeholders in support of the AAS performance objectives and the European operational and technical harmonisation objectives;
- "Quick-wins" that, if implemented in a short-term timeframe, would provide significant network performance improvements e.g. changes of existing operational procedures, Operational utilisation of resources;

The demonstrations shall provide quantitative figures regarding the benefits at network level compared to a nominal scenario where improvements are not considered. These benefits shall be measured according to the SESAR performance framework as outlined in the Execution Guidelines.

The demonstration may consider the following scope:

- **Initial dynamic airspace configuration and application of A-FUA and ATFCM**. The scope may address initial steps towards dynamic airspace configurations aiming at improving the use of airspace capacity for both civil and military users by increasing the granularity and the flexibility in the airspace configuration and management within and across ANSPs' areas of responsibilities. This concept addresses the integration of concepts and procedures to allow flexible sectorisation boundaries to be dynamically modified based on demand. This includes potential implications for ATCO licences, international boundaries and potentially IOP and A/G multi-datalink communication capabilities.

- **Show case initial strategies to delegate air traffic services amongst ATSUs and capacity-on-demand arrangements:** The low resilience of the current system is due in part to the fact that it relies on the provision of local ATM services for a defined geographical area. When disturbances occur, the system cannot use remote services to mitigate the impact of a disturbance, while recovering and resuming normal operations, unless traffic can be re-routed via providers with spare capacity. The capacity-on-demand service aims to ensure the continuity of air traffic service provision despite disruptions. It goes beyond the current static arrangements for cross-border delegation of ATS. The aim is to ensure the continuity of air traffic services by enabling more dynamically a temporary delegation of the provision of air traffic services to an alternate centre with spare capacity arrangements for cross-border delegation of ATS

- **Gradual transition towards higher levels of automation** in particular smaller adaptations to systems, systems connectivity and interoperability, etc.

2.3 Expected Impact:

The dynamic airspace management concept contributes to resilience, capacity and cost-efficiency. It aims at delivering substantial network performance through closer collaboration between ATM actors.

3 Topic 2: Integrated Trajectory Management

3.1 Specific Challenge:

In order to handle the increased air traffic and future airspace demands, controllers, pilots and advanced system functions will all need to share the same information about flights and use automated tools that assist in detecting, analysing and resolving any potential conflicts as well as monitoring the adherence to agreed trajectories.

Trajectory representing the business/mission intentions of the Airspace Users and integrating ATM and airport constraints should be elaborated and agreed for each flight, resulting in the reference trajectory that the Airspace User agrees to fly and the ANSP and Airport agree to facilitate.

A first step to address the challenge is to support the AAS TP MEASURE 2 "Realise planned implementation related to mature SESAR Solutions supporting the implementation of cross-border free route, air-ground and ground-ground connectivity" and demonstrate the benefits.

3.2 Scope:

The demonstration activities under this topic aim at the demonstration of operational improvements that contribute to realise measure 2 in the AAS TP including:

- Forward looking concepts that have been already validated by SESAR activities (SESAR catalogue[4]);
- Elements that, being are still under validation in SESAR under the scope of Wave 2 SESAR solutions, could transition towards industrialization in short-term.

The objective of this VLD is to demonstrate, in a consolidated and integrated manner, the real time synchronisation of trajectory information between all involved stakeholders. Trajectory-based operation includes the management of Trajectories focussing on the flight needs in four dimensions through the lifecycle of planning, execution and post-flight analysis. The aim of the TBO is as described in SESAR and ICAO to improve performance of air traffic operations and increase the overall predictability of the air traffic system. The 4D Trajectory (4DT) information set encompasses relevant trajectory flight data, including latitude, longitude, altitude, and time. This information is available in different formats and in different parts of the ATM system (airborne, network, ANSP).

The demonstrations shall provide quantitative figures regarding the benefits at network level compared to a nominal scenario where improvements are not considered. These benefits shall be measured according to the SESAR performance framework as outlined in the Execution Guidelines.

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[4] SESAR Solutions Catalogue :
https://www.sesarju.eu/sites/default/files/documents/reports/SESAR_Solutions_Catalogue_2019_web.pdf

The demonstration may consider the following scope:

- **Free routing operations in cross-border environments**;
- **Automated support** for adapting the capacity with evolving demand taking into consideration the traffic needs and sector configurations. An optimised sector planning on the day of operations and a better management of staff resources would result in a better use of airspace and human resources, improved safety due to early management of constraints, and fewer delays. Optimised and coordinated organisation of airspace activations and reservations, able to support optimised traffic flows in a free route environment as well as other uses of airspace (e.g. military);
- **Cross-border interoperability of mission trajectory elements** from planning phase to execution phase and the mission trajectory integration at regional level e.g. improved OAT flight plan;
- **Enhanced automation support for controllers** e.g. Integrated tactical and medium Conflict Detection & Resolution (CD&R) services and Conformance Monitoring tools for En-Route and TMA;
- **Enhanced integration of AU trajectory definition and network management processes**: The objective of this feature is to reduce the impact of ATM planning on Airspace Users' costs of operations, by providing a better access to ATM resource management and allowing to better cope with ATM constraints. This shall improve Airspace Users flight planning and network management through improved FOC participation into the ATM network collaborative processes in the context of FF-ICE and its potential evolutions.
- **Enhanced Network Traffic Prediction and shared complexity representation:** This concept aims at improving the accuracy of the network manager traffic prediction from medium-term planning phase to execution, relying in particular on new trajectory management features such as the preliminary FPL. It includes adapting existing methodologies and algorithms for demand prediction and regional complexity assessment.
- **ATM data service provision :** supporting the progressive shift to a new service delivery model for ATM data, through the establishment of dedicated "ATM data service providers" (ADSPs). The ATM data services provide the data and applications required to provide ATS and include flight data processing functions like flight correlation, trajectory prediction, conflict detection and conflict resolution, and arrival management planning. These services rely on underlying integration services for weather, surveillance and aeronautical information. The maximum scope of service delivery by ADSPs covers the ATM data services (such as flight data processing) needed to realise the virtual de-fragmentation of European skies and includes the provision of AIS, MET and CNS services
- **Air-ground and ground-ground connectivity**: opportunity to show case technical means that are in the pipeline for implementation and will enable the exchange of digital information in support of collaborative management of airspace and remote provision of air traffic services:
    - **Air-ground Data link and the integration of Extended Projected Profile (EPP) into the ground systems**. The airborne trajectory prediction performed by the Flight Management System (FMS) takes into account flight performance data that is updated in real time during the execution phase, such as descent planning information, aircraft

weight, and the most updated temperature and wind predictions. This feature allows the downlinking of data based on the airborne trajectory prediction using the Extended Projected Profile (EPP), as defined by the Aeronautical Telecommunications Network Baseline 2 (ATN B2). The downlinked data is used by the ground systems to enrich their trajectory prediction;

- **Information Exchanges using the SWIM Yellow Profile**;
- **eFPL supporting SBT transition to RBT:** The distribution of eFPL information to ATC systems, and at the possible improvements of the alignment of AUs' and NM's trajectories especially concerning use of PTR s and Standard Instrument Departure (SID)/Standard Arrival Route (STAR) allocation

3.3 Expected Impact:

Through continuous exchange of up-to-date and consistent trajectory information between all units, the VLD will demonstrate more efficient operations, from tactical planning and complexity management, to early conflict detection and arrival management.

4 Topic 3: U-space capabilities and services to enable Urban Air Mobility

4.1 Specific Challenge:

In the future, mobility as a service will improve inter-modality connecting many modes of transport into seamless door-to-door services for people and goods. There will be increasingly diverse aircraft in the European skies at any moment in time than ever before, and drones (civil and military) will be completely and seamlessly integrated into all environments and classes of airspace, operating safely and efficiently alongside manned aircraft.

Latest industry progress in battery technology and electric propulsion is prompting the emergence of a wide range of new air transportation applications improving, even further, the efforts to reduce noise and CO_2 emissions. This evolution, amongst others, opens the door to alternative responses to the increasing transportation demand in large cities. Urban air mobility (UAM) will feature operations by new types of VTOL aircraft in new roles, such as "flying taxis" operating over suburban and urban areas. UAM starts with conventional air vehicles such as manned helicopters, and introduces new aircraft types with alternative propulsion and new vehicle designs that are increasingly automated and remotely piloted. There are a number of related projects around the world, some already experimenting with aerial prototypes. As well as needing to work alongside manned aviation and air traffic control (ATC), UAM will also be one of the most demanding use cases for U-space, services of which will need to be validated by SESAR.

4.2 Scope:

The objective of this VLD is to demonstrate the safe integration of UAM as additional airspace user.

Urban Air Mobility (UAM) refers to the provision of mobility services in an urban environment using air vehicles. These vehicles encompass everything from manned helicopters, as currently flown, through small inspection and delivery drones to 'flying taxis', with or without a pilot. As this important and growing domain evolves, it is clear that new operational concepts, regulations and standards will be needed, underpinned by existing and new technologies. The whole environment will need to integrate safely with manned aviation and air traffic control.

SESAR's ongoing Exploratory Research (ER) programme into U-space is conducting detailed research into U-space in the Urban environment, and this VLD complements this by conducting flying demonstrations to demonstrate and test developments in UAM. Coordination between this VLD and the ongoing ER projects is an essential requirement. The results of the VLD will help to refine the safety, performance, standardisation and regulatory requirements to enable UAM.

The VLD will include the following activities:

- Execution of flight demonstrations in accordance with the safety conditions (A significant number of flights is expected to take place with operating methods produced by the project, in coordination with relevant stakeholders, and using one or more eVTOL platform carrying human passengers), the demonstration flights should also include vehicles with full autonomous capabilities;

- As a result of the demonstration flights, the Demonstration Report will :
  - Describe guidelines for safe UAM operations, proposals for regulatory change that may be needed, and recommendations for associated means of compliance (close coordination with EASA is required to ensure complementarity and consistency with EASA activities);
  - Propose operational procedures and mechanisms for an effective interface with ATC and U-Space service providers;
  - Address safety, certification and regulatory needs, (close coordination with EASA will be required in particular for the possible application of the Specific Operations Risk Assessment (SORA));
- Attention is drawn to consider existing references to ensure:
  - Building and possibly further extending U-space requirements and CONOPS in order to address the specificities of UAM (including the CORUS conops[5] and the outcomes of the Gulf of Finland (GOF) U-space project[6], which included UAM operations, where a manned prototype eVTOL aircraft was flown inside the Helsinki CTA). These requirements could address Airspace classification and management; Avionics, including communication, navigation and surveillance; Connectivity requirements; and U-space services specifically supporting urban air mobility
  - Building on and proposing possible refinement to U-space architecture principles[7] and to the first U-space "State of the Art" report integrating all SESAR U-Space projects outcomes (available in March 2020);
  - Consolidating requirements with the concept of smart cities[8].

4.3 Expected Impact:

The demonstration is expected to significantly contribute to the safe integration of UAM as additional airspace user.

[5] CORUS CONOPS : https://www.sesarju.eu/node/3411

[6] GOF Results: https://www.sesarju.eu/node/3203

[7] Initial view on principles for the U-space architecture https://www.sesarju.eu/node/3402

[8] European Commission Initiative: Cities using technological solutions to improve the management and efficiency of the urban environment; http://ec.europa.eu/eip/smartcities/index_en.htm.

5 Topic 4: Environmental sustainability

5.1 Specific Challenge:

With the growth in air traffic come concerns about its environmental and health impact. These concerns in Europe and worldwide are prompting the aviation industry to step up its efforts to address the environmental sustainability of air travel to reach the carbon neutral goal of the EU by 2050.

By taking a holistic view at the trajectory from beginning to end, the trajectory-based operations concept will enable airspace users to operate their preferred trajectory from gate to gate, in order to satisfy their business and operational needs, such as 4D trajectory optimisation during the planning and also the execution phase. By optimising aircraft trajectories, TBO also supports the reduction in gate-to-gate CO2 emissions and reduction in fuel burn per flight. Its benefits will be further enhanced when combined with solutions such as continuous descent and climb, which will reduce both emissions and noise and, possibly, contrail formation.

5.2 Scope:

This VLD aims at demonstrating ATM operations mitigating aviation's environmental footprint and significantly contributing to the reduction CO2 emissions. Applicants are invited to promote and demonstrate "**zero CO2 waste**" trajectories. Projects are encouraged to explore the possibilities for **protecting green flights** and environmentally optimised trajectories from unnecessary deviations or other constraints.

The demonstrations shall provide quantitative figures regarding the benefits in terms of CO2 emissions due to these ATM improvements compared to a nominal scenario where improvements are not considered e.g. based on historical data. These benefits shall be measured according to the SESAR performance framework as outlined in the Execution Guidelines.

It is expected that the demonstration report provides an analysis on how the measured benefits could be extrapolated at ECAC area.

This demonstration requires the participation of airspace users.

The demonstration may consider the following scope:

- **Protect green flights :** In the context of best equipped – best served concept, prioritising low emission aircraft (at airport, En-route or network level) in terms of trajectory, has the potential of accelerating the market uptake of green aircraft.
- **Propose solutions aiming at achieving "zero CO2 waste" trajectories :** this includes enabling aircraft to fly the most fuel efficient and environmentally efficient trajectories. Beyond the traditional Improvement of climb/descent profiles and performance based navigation, the "zero fuel waste" challenge consists in designing the "perfect flights" from an emission perspective, then during the execution, possibly eliminating all possible ATC interferences (with the perfect trajectories) that would result into a degradation of the optimum and thus generating extra emissions.

- **Show case ATM operational improvements that contribute to reduce the amount of aviation's CO2 emissions in Europe**:
    - These improvements can be either relevant solutions included in the SESAR catalogue, other existing operational improvements from the ATM Master Plan or even new ones targeting the same objective: reducing CO2 emissions.
    - The demonstrations will ideally comprise gate-to-gate scenarios that include a combination of relevant operational improvements covering both planning and execution phases (from airport origin to airport destination) as for example: autonomous and/or non-autonomous engine-off taxi, automated assistance to controllers for surface movement planning and routing, trajectory based Integrated Runway Sequence, continuous climb operations, free routing, network improvements aiming at improving horizontal and vertical flight profiles, extended AMAN, continuous decent operations, environmental friendly approach procedures, etc.
- The demonstrations may also address the ATM role in reducing **other emissions beyond CO2 e.g. NOx**;
- **Synergies with promising decarbonisation initiatives:** Projects are encouraged to find synergies with promising initiatives (such as alternative fuel, electrification...) that when combined with appropriate ATM measures could result in a great saving in emissions.

5.3 Expected Impact:

This demonstration is expected to significantly contribute to the environmental sustainability of ATM operations.

6 Additional considerations

6.1 Specific considerations

The demonstration activities will aim at bridging the gap between development and implementation by accelerating market uptake of the next generation SESAR capabilities and services and serve as an acceleration platform for 'early movers'. Demonstrators shall include testing in live environment of concepts, services and technology supporting the achievements of the objectives outlined in the European ATM Master Plan. Projects should be focused at building confidence from the supervisory authorities and operational staff by establishing further performance and safety evidence.

For topics 1 and 2 alignment and complementarity with the measures foreseen in the Airspace Architecture Study Transition Plan are particularly sought after and need to be demonstrated taking due consideration for the role and tasks of the Network Manager as defined by Implementing Regulation (EU) 2019/123[9].

In order to adequately respond to the aspirations of the ATM Maser Plan and Airspace Architecture Study Transition Plan , applicants are invited to take into account the following considerations:

- Demonstrating added value for the ATM network:
    - Relevance with regards to the hotspots identified in the AAS Transition Plan
    - Cross border operations: proposals may include at least a minimum of two different ANSPs involving cross border operations in the context of the proposed demonstrations
    - Defragmentation of service provision: promoting a common service architecture across the European ATM system;
    - Interoperability: enabling the seamless exchange of information between systems;
    - sharing of infrastructure: promoting the efficient and shared use of infrastructure such as CNS;
    - Scalability: delivering Solutions that enable the ATM System to be enlarged, to easily adapt operational capacity to meet demand.
- Demonstrating that the solution development will ensure an implementationoriented outcome.

6.2 Project execution and delivery

The "**Project Execution Guidelines for SESAR 2020 Project Execution Guidelines for SESAR 2020 VLD demonstrations awarded under Open Calls**" provides the necessary instruction about the project execution and delivery. This document will be made available together with the call specifications.

In particular, in the case of this call, a continuous feedback to the SJU on the maturity of the demonstrations is required. It is also expected that demonstration plans and reports will be public.

[9] Commission Implementing Regulation (EU) 2019/123 laying down detailed rules for the implementation of air traffic management (ATM) network functions and repealing Commission Regulation (EU) No 677/2011 (OJ L 28, 31.1.2019, p. 1).