Accelerating the implementation of a New Service Delivery Model for ATM in Europe

Edition date:	**03 July 2025**
Edition:	**01.00.01**
Status:	**Final**
Classification:	**Public**

Abstract

This document sets out the minimum level of Level 2 service decomposition for a typical Area Control Centre (ACC) in Europe, necessary to fulfil the ambition of SDO8 as defined in the European ATM Master Plan and jointly agreed by Air Navigation Service Providers and the ground systems manufacturing industry who have signed the Joint Statement either on June 2024 or subsequently in early 2025.

A separate companion document outlines supporting harmonisation principles to be considered in the upcoming development of the joint SESAR–EASA roadmap; these are presented for reflection, recognising that discussions on this topic are still ongoing.

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Document History

Edition	Date	Status	Author	Justification
00.01.00	28 April 2025	Final Approved by TF for awareness campaign	Frédéric Lecat	Addresses comments raised by TF members
00.02.00	26 June 2025	Final Approved by TF for handover to SJU	Frédéric Lecat	Addresses comments raised in the awareness campaign
01.00.00	03 July 2025	Final Approved by SJU for publication	Ruben Flohr	Minor editorial changes by SJU
01.00.01	07 July 2025	Final Approved by SJU for publication	Ruben Flohr	Layout error corrected

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1 Executive summary

In order to achieve the objectives of handling the future growth and diversity of air traffic safely and efficiently, while minimising environmental impact, Air Navigation Service Providers (ANSPs) ambition to leverage on the latest digital technologies to enhance overall ATM service provision with better flexibility, scalability, resilience and pace of innovation.

Current challenges

Europe's Air Traffic Management (ATM) system is indeed at a critical juncture. The current reliance on legacy, monolithic systems has led to mounting technical debt, inefficiencies, limited flexibility, long system lifecycles and misalignment between stakeholders' ATM systems roadmaps across the continent. This is hindering the ability of Air Navigation Service Providers to innovate, scale, and respond effectively to evolving operational demands and regulatory expectations.

A recent survey conducted by the EUROCONTROL Open Digital Architecture Task Force revealed that only 5 ANSPs (handling 7% of 2019 traffic) among the 25 in Europe consider their current architecture to be fit for purpose. Today, ANSPs expect to gain innovation speed for new features, technical streamlining to pay back the current technical debt (18 ANSPs), deployment time and cost savings (18), gains in reliability and scalability (15), faster integration of operational automation/functions (16) to quickly cope with new market realities of the European Sky, operational efficiencies and cost control, while at the same time assuring the highest safety level.

The vision

To meet the ambitious operational and technical improvements outlined in the **ATM Master Plan for 2025-2045 [1]**, a fundamental shift towards a modern, agile, and service-based architecture is imperative. This transition necessitates overcoming financial shifts and technical debt, while fostering an open-market ecosystem that encourages innovation and accelerates development and deployment towards safe operations.

This document defines a **single, harmonised target model for service delivery in European ACCs for SDO8 as per the European ATM Master Plan**. This reference reflects the consensus of the Service Delivery Model Task Force and takes into account a consultation targeting all ANSPs in Europe. It is not a menu of options or a set of possible futures. It is a unified vision, grounded in the architectural direction of the ATM Master Plan and intended to guide investment, regulation, and collaborative innovation.

While this vision offers a clear picture of what success for the implementation of SDO8 should look like, it does not prescribe how or when each stakeholder must get there. The pace and path of adoption will necessarily vary between ANSPs, depending on operational context, supporting platform maturity, and the regional regulatory context.

The recommended minimum Level 2 service breakdown

This document should be understood as **the SESAR reference for how success should look like**, not an implementation guide. It supports **alignment around a common future architecture model,** while respecting diverse starting points and responsibilities.

It supports:

- Faster innovation through modular, plug-and-play services;
- Cost control and operational efficiencies via a multi-vendor ecosystem;
- Improved scalability, reliability, and integration of automation; and
- Strategic alignment across ANSPs, industry players, and regulators.

Flexibility in **local procurement or rollout strategies** remains possible but always within this shared reference, ensuring technical, operational and regulatory alignment across Europe as we embark on this new era for transformation of ATM in Europe.

A key aspect of this transformation, as detailed in this document, is the **decomposition** of ATM functionalities into a minimal set of well-defined services, building upon the Level 1 business services defined in the ATM Master Plan and further detailing them at Level 2. These **self-contained, interoperable, interchangeable, procurable, and deployable** Level 2 services will enable a **multi-vendor ecosystem,** where ATM Data Service Providers (ADSPs) and integrators can contribute to service delivery in a safe and secured manner.

Next steps

This approach is intended to inform the work about a future Common Project 2 regulation. For these reasons, transition planning will also be addressed in a dedicated SESAR-EASA roadmap to be delivered by end of 2025.

The present Level 2 service breakdown constitutes a **minimal decomposition**.

The scope of the decomposition is intended as exhaustive for Area Control Centres (upper airspace) and could be expanded to the lower airspace to enable full leverage of the delivery model.

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2 Introduction

2.1 Task Force objectives

To de-risk the transition to implementation of SDO8 and provide a clear reference point for all, the Task Force had to deliver a **Level 2 services breakdown** and **harmonised principles** fully in line with the content of the proposed update of the European ATM Master Plan [1] that facilitates:

- Open ATM patterns enabling integration of components provided by various system providers to facilitate multi-vendor solutions using open platforms and interfaces,
- Decoupling of service and infrastructure layers as defined in the ATM Master Plan through adherence to cloud-native architectures and technologies (including the various system components), and
- A cloud native architecture of components with standardised and open interfaces that can be deployed on commodity cloud technologies.

2.2 Key output

Key features of the model include:

- Minimum level of decomposition of ATM functionality into interoperable Level 2 services, building on Level 1 business services in the Master Plan (this document);
- A separate companion document outlines supporting harmonisation principles to be considered in the upcoming development of the joint SESAR–EASA roadmap; these are presented for reflection, recognising that discussions on this topic are still ongoing. These proposed harmonisation principles include a framework intended for SDO#08 implementation.

2.3 Composition of the Task Force and consultation process with the broader ANSP community in Europe

The Task Force was composed of Chief Architects from A6 ANSPs and major ATM industry suppliers, with the support of an expert from EUROCONTROL:

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Table 1 Task Force Composition

At the end of April the Task Force draft report was made available to all the ANSPs of the ECAC area for an awareness-raising campaign (leveraging the SESAR Deployment Manager consultation arrangements). Together with the draft report, the ANSPs were requested to fill-in a questionnaire prepared by SJU+Task Force. At the same time the report was shared with the members of the SJU Programme Committee and with EASA.

All replies and comments received were aggregated, presented and discussed during an open awareness-raising workshop hosted by DFS in Langen at the end of May. The workshop, held in hybrid form, was the opportunity to present in details the different chapters of the draft report, address specific comments and questions received beforehand and identify the areas of the report requiring additional work in preparation of the final report.

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After the workshop, the Task Force has proceeded towards the finalisation of the report, by taking into account at the maximum extent possible the outcomes of the questionnaires and of the awareness-raising workshop.

2.4 Intended readership

The document is primarily aimed at Chief Technical Officers, enterprise architects, and strategists from ANSPs, ADSPs, and ATM industry suppliers.

It is designed to assist the broader ATM ecosystem in developing a regulatory framework that supports a modern, service-oriented approach to Air Traffic Management in Europe.

While targeting a wide audience within the ATM ecosystem, the focus is particularly on European ANSPs, their technology suppliers, the SESAR Deployment Manager and EASA.

3 Why a service-oriented approach is needed

3.1 Current challenges

Take away: The current Air Navigation Service Provider (ANSP) delivery model is based on outdated, fragmented systems with limited interoperability, leading to high technical debt and increased costs. A transition to modern, flexible architectures, as well as more agile processes is needed but faces challenges such as regulatory constraints, financial shifts, and technological debt. The industry must embrace innovation and new service-oriented architectural models to improve efficiency and reduce time-to-market.

The current delivery model of each Air Navigation Service Provider (ANSP) relies on legacy applications, which are primarily monoliths with accumulated technical debt.

ATC systems continuously evolve to address emerging operational needs, regulatory requirements, and the adoption of new technologies driven by market trends and system renewal requirements.

As a result, current ATC systems exist with different architectures and functional distributions across their components. The components maintain their own airspace model, which makes the ATC systems highly fragmented. The fragmentation of the ATC has led to high technical debt, increased cost and time required to deploy new features. Hence, ATC systems in operation exhibit a high level of customisation with limited global interoperability. This situation across all stakeholders in Europe has resulted in varying operating procedures, restricted product competition, and complex, tailored cost-sharing models.

These challenges are confirmed by a recent survey performed by the NDTECH Open Digital Architecture (ODA) Task Force early 2025. A summary of the results from this survey is shown in the Figure 1 below.

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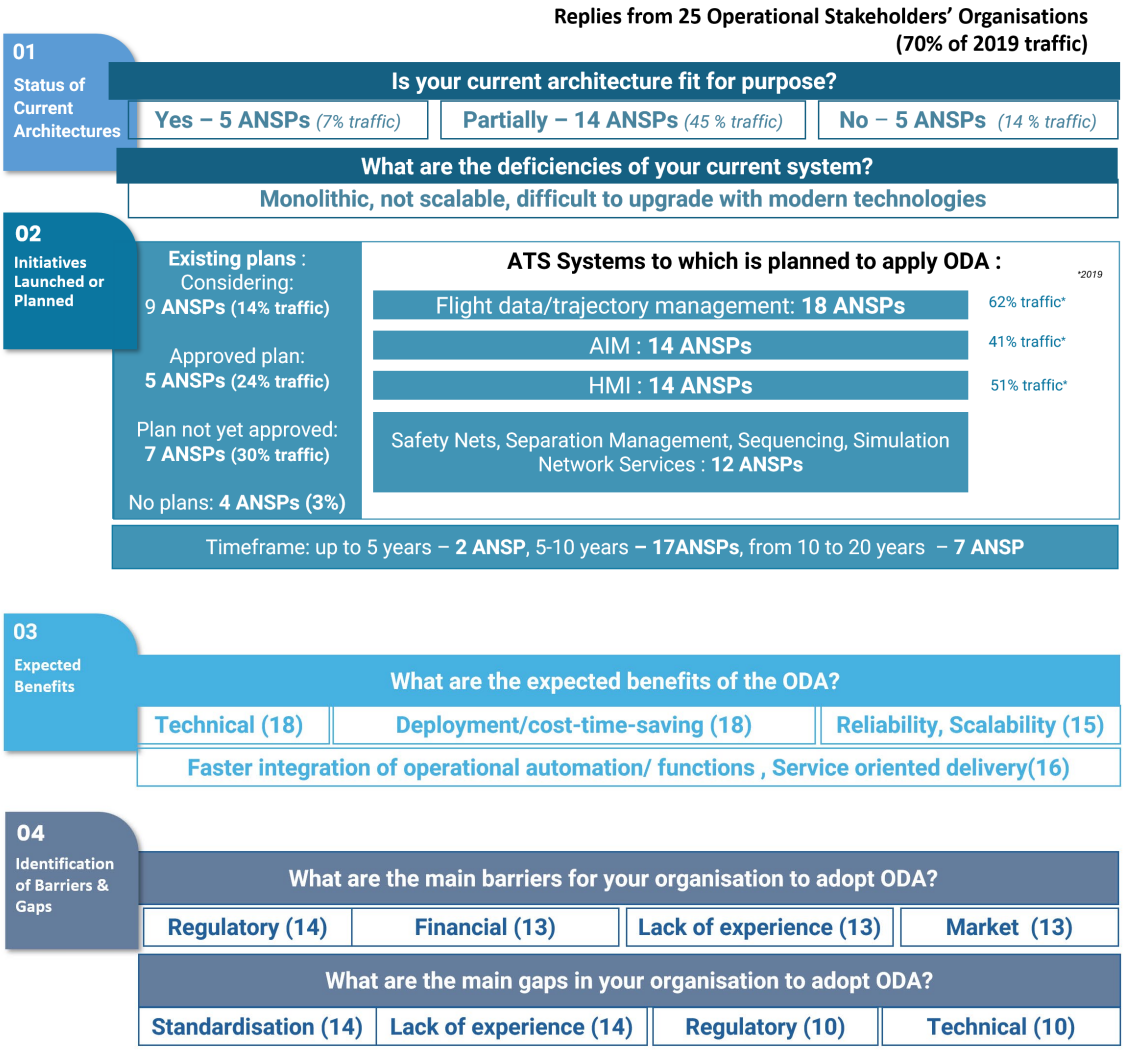


Figure 1 NDTECH ODA adoption survey results

The results show that only 5 ANSPs (handling 7% of 2019 traffic) consider that their current architecture is fit for the purpose, while the 20 others consider that it is not or only partially the case.

Only five Air Navigation Service Providers (ANSPs), accounting for 24% of the traffic, have an approved plan to transition to an Open Digital Architecture (ODA). Of these, only two ANSPs are expected to implement the plan within the next five years. In contrast, 13 ANSPs, representing 54% of the traffic, are either considering or do not have an approved plan yet, but they intend to implement ODA within the next 5 to 10 years. Seven of these ANSPs are planning for a timeline that extends beyond this period. The top three services prioritized for ODA implementation are Flight Data/Trajectory Management, involving 18 ANSPs and 62% of the traffic; Human-Machine Interface (HMI), involving 14 ANSPs and 51% of the traffic; and Aeronautical Information Management (AIM), involving 13 ANSPs and 41% of the traffic.

It was highlighted that the active involvement of industry stakeholders, is crucial for the successful implementation and advancement of ODA.

During the awareness-raising campaign, 3 ANSPs mentioned however that their current baseline of ATM system already includes several key enablers that will support a smooth and effective transition to the new service delivery model. They operate flexible, scalable ATM systems whose architecture allows agile system changes at a pace of a major change every 2 to 4 years. This remains below the ambition of the New Service Delivery Model of 1 to 2 majors changes a year.

In response to the limitations of the current delivery model, transitioning towards a modern, agile, and service-based architecture offers great potential. However, this shift also introduces regulatory, operational, and technological challenges that must be carefully managed.

3.2 The need for accelerating innovation

Take away: Many operational and technical improvements are planned for the next two decades 2025-2035 (phase C) and 2035-2045 (phase D). At the current pace, the current development, standardisation, certification and deployment processes would not allow to meet the target dates and bring about the expected benefits and operational performance improvements. Air Traffic Control (ATC) systems need to adopt a service-based delivery model and leverage cloud technologies to meet the ambitious timelines set by the ATM Master Plan for 2025-2045. This transformation aims to streamline operations, enhance efficiency, and accelerate innovation, enabling faster deployment and integration of advanced technologies. By embracing agile approaches, modern architecture patterns and improving data management, ANSPs can overcome current limitations and achieve significant operational improvements.

Significant operational and technical advancements in ATC systems are planned for the next two decades: Phase C (2025-2035) and Phase D (2035-2045), following the guidance of the ATM Master Plan (ATM MP). The demand for increased traffic capacity and adaptability to evolving traffic patterns, including the integration of new airspace entrants, requires faster innovation and operational improvements.

Many states and regions are already investing in Trajectory-Based Operations (TBO), higher levels of automation, human-machine teaming, virtual centres, and specific use cases such as cross-border operations, delegation of service provision, and resilience-enhancing solutions.

However, **at the current pace of development, standardisation, certification, and deployment, the industry will struggle to meet these target timelines**. As a result, ANSPs will be unable to fully realise the expected benefits and operational performance improvements associated with this evolution. Reaching higher levels of automation in ATM in the next decade requires to **unlock data** from the building blocks of the ATM products and provide interoperability.

In recent years, the IT industry has driven the adoption of a new business and service delivery model, which ANSPs and its corresponding ATC systems must embrace to overcome the limitations of the current approach, within the safety framework. **The service-based delivery model accelerates the update cycle**, serving as a catalyst for achieving the objectives outlined in the ATM Master Plan. This transformation leverages new platforms, commercial off-the-shelf (COTS) solutions, and cloud technologies to streamline operations. By shifting to this architectural model, by offloading infrastructure-related concerns (e.g., hardware, communications, databases), a **focus on core ATM**

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business processes is made possible. By integrating cutting-edge technologies and a cloud-based approach, the New Service Delivery Model enhances efficiency and effectiveness, accelerating the pace of innovation, development, and deployment across Europe and individual states.

The breakdown into more fine-grained services, required standardisation and certification work might however slow down the overall pace of delivery of changes to the functional systems of ANSPs and benefits for airspace users. To prevent delays, a **robust coordination system** should be put in place.

To this end, the Task Force **proposes** the establishment of a cooperative, SDO#08 implementation framework in a **companion document**.

The essential features of this SDO#08 implementation framework are to federate existing stakeholders in a streamlined, region-wide coordinated process, driven by consensus, and relying on a commonly agreed set of standard operating procedures to be able to scale up the delivery of the Level 2 services by multiple vendors for Europe-wide ATM operations.

3.3 The ATM Master Plan vision

Take away: The delivery model aims to facilitate the seamless integration of new services and components from various system providers within an open-market ecosystem.

As a follow-up to this vision, this document outlines a single, harmonised target architecture to be achieved by 2035 across European ACCs.

The delivery model promoted in the ATM Master Plan 2025 ambitions to support:

- The seamless integration of new services;
- The integration of components provided by various system providers; and
- An open-market ecosystem.

The Figure 2 depicts an overview of the delivery model and high-level architecture and summarises the advantages of such architecture as follows:

- Support of advanced human–machine interaction (increased automation and faster innovation pace);
- Open or standardised interfaces;
- Open, composable, service-oriented application architecture;
- Composable multi-vendor solutions. Secure shareable governance;
- Highly scalable services;
- Certifiable services;
- Location-independent redundant service provision (resilience);
- Support of cloud-based business services;
- Easily integrable new services (expanding faster innovation pace);
- Separated service and infrastructure layers; and

- Support of on-premises infrastructure but also public, private and hybrid cloud infrastructure.

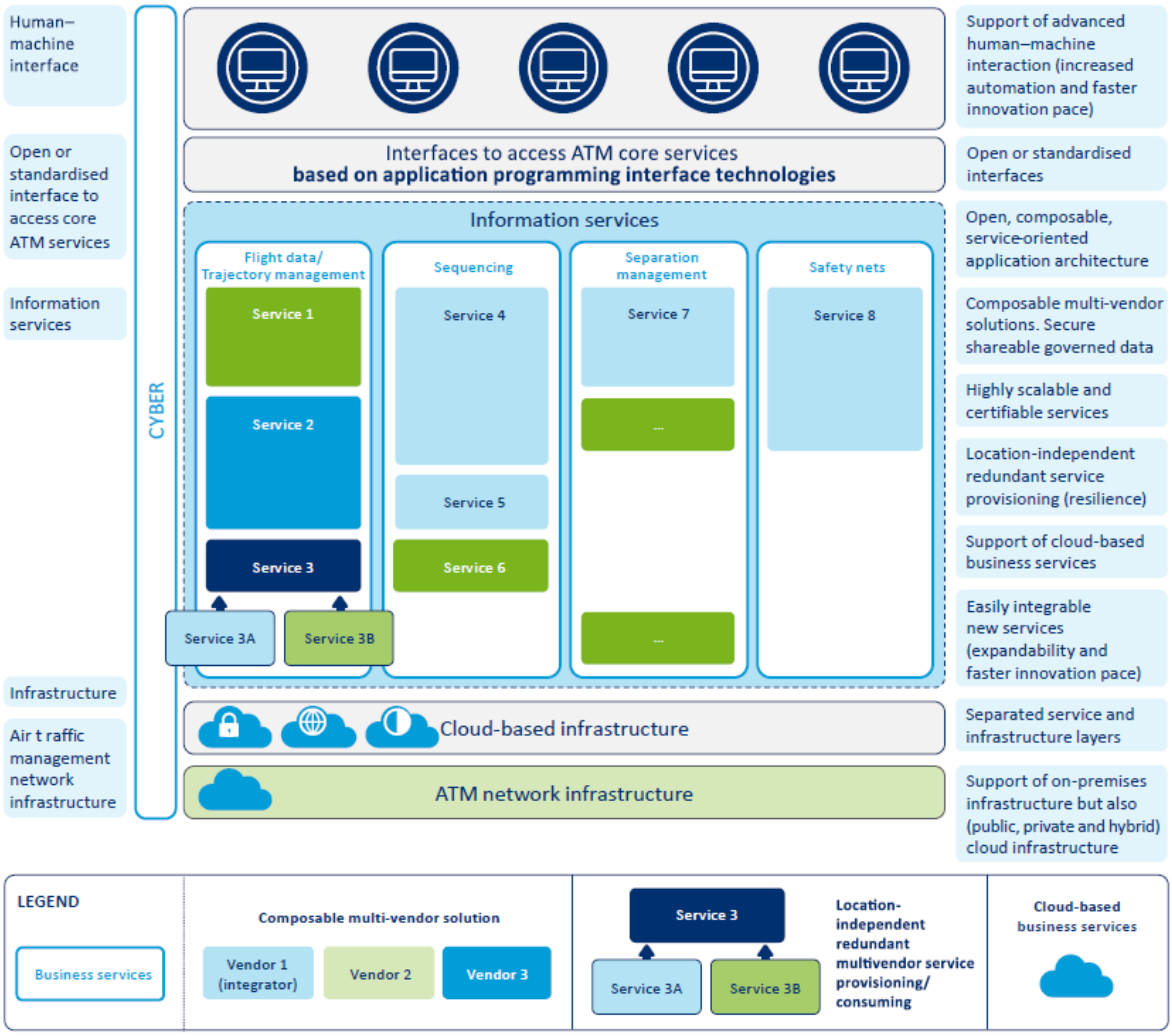


Figure 2 Visualisation of the New Service Delivery Model for a typical ACC [ref. 1]

The New Service Delivery Model demonstrated in Figure 2 was defined by the Task force and is featured in Appendix F.

3.4 A call for action: launching the SESAR New Service Delivery Model task force

Take away: In June 2024, a joint statement was signed by the CEOs of A6 Alliance of air navigation service providers (COOPANS, DFS, DSNA, ENAIRE, ENAV, NATS, PANSA, Skyguide) and general managers from industry manufacturers, supporting a transition to a New Service Delivery Model for Air Traffic Management (ATM) in Europe, under the SESAR umbrella. A Task Force was established to

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develop harmonisation principles and a Level 2 services breakdown to facilitate open ATM patterns, multi-vendor solutions, and a cloud-native architecture, aligning with the ATM Master Plan 2025.

In June 2024, a joint statement was signed[1] by the CEOs of A6 Alliance of air navigation service providers (COOPANS, DFS, DSNA, ENAIRE, ENAV, NATS, PANSA, Skyguide) and general managers from industry manufacturers (Indra, Leonardo, Frequentis and Thales) in support of a transition to a New Service Delivery Model for ATM in Europe.

> *"For this implementation to be a success, we commit to working together in a spirit of collaboration, trust, and partnership under the SESAR umbrella (SESAR Joint Undertaking and SESAR Deployment Manager), together with other SESAR participants and partners who are willing to join this statement and also support operational use."*

First step to support the transition and the objectives of accelerating pace of innovation, development and deployment, a Level 1 (L1) breakdown of the ATM system in business services was defined and later included in the ATM Master Plan Appendix A.7.

This breakdown into L1 services was not considered sufficient to support the objectives. Therefore, a further breakdown into Layer 2 (L2) Services was proposed. To ensure a logical and traceable breakdown, it was proposed that principles should serve as the basis for shaping the end result. It was decided that the task of developing such principles (called harmonisation principles) and implementing a breakdown of L1 services into L2 would be carried out by a joint task force with members from A6 and the ATM industry together with SJU.

The task force started the work in October 2024 and the main deliverables are:

- The Level 2 services breakdown, which is presented in the chapter 4,
- Harmonisation Principles, presented in the companion document.

The objective of the Task force was to reduce the risks of transitioning to the architectural features described in SDO#8 and to develop harmonisation principles that are fully in line with the content of the ATM Master Plan 2025, thereby facilitating:

- Open ATM patterns enabling integration of components provided by various system providers to facilitate multi-vendor solutions using open platforms and interfaces;
- Decoupling of service and infrastructure layers as defined in the ATM Master Plan through Cloud Computing (including the various system components); and
- A cloud native architecture of components with standardised and open interfaces that can be deployed on commodity cloud technologies.

[1] SESAR Joint Undertaking | Call to action! Transition to New Service Delivery Model for European air traffic management

It was reiterated in the awareness-raising campaign that the establishment of scalable, resilient, open-service oriented platforms and cloud-based architectures is fully supported by the ANSPs. This will enable the New Service Delivery Model and with it many other important functionalities such as TBO, accelerating and facilitating the speed of change.

This was fully recognised by the convergence and support to the ATM MP SDO8 and by signing the Joint Statement on the Transition to a New Service Delivery Model for ATM in Europe in June 2024 by a large number of stakeholders including the A6 alliance and key Manufacturing Industries in the sector.

However, the transition to SDO8 requires still several steps to be developed, standardised and promoted in the market. Therefore, the ANSPs consider it is not possible to accelerate the roadmap provided within SDO#8 of the ATM Master Plan which ambitions the implementation of SDO8 by 2035.

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4 Level 2 Service Breakdown

Take away: The ATM Master Plan outlines business services on Level 1. This document further highlights the need for a more granular breakdown of services into Level 2 to enhance flexibility, interoperability, and operational performance, allowing for more efficient air traffic control operations and improved service delivery through well-defined interfaces and protocols and proposes such a breakdown.

4.1 Level 1 Business Services Overview

The business services on level 1 were laid out in the ATM Master Plan. The business services represent functionalities and important technical components of the ATM.

This document talks about business services and IT services or simply services, which are used interchangeably through this document.

The Level 1 services are depicted in the Figure 3 and described further in the Table 2.

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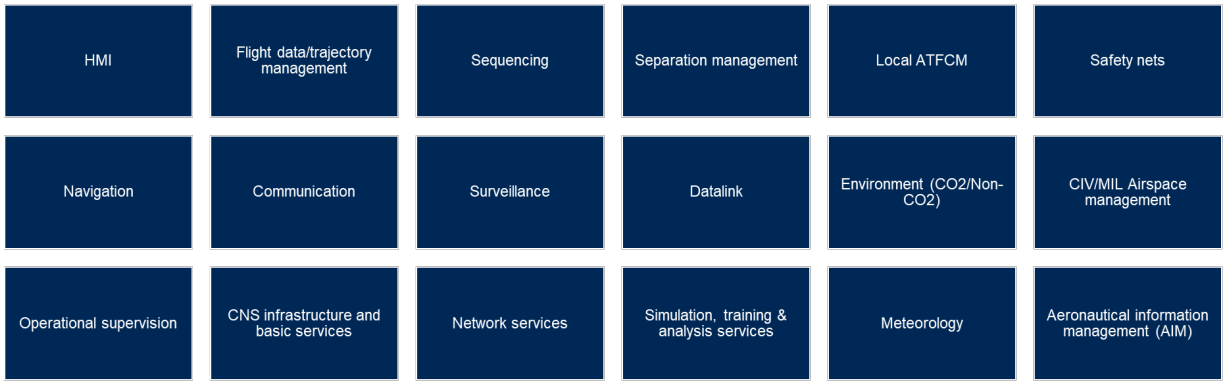


Figure 3 Level 1 Business Services as per the MP in relation to SDO8 for a typical ACC in Europe (Ref. Annex 7 of the Master Plan)

L1 Business service (for a typical ACC)	Examples of functions covered by the business service
HMI	Air situation display, alerts, flight editing and dialog, attention & fatigue, speech recognition.
Flight data/trajectory management	4D trajectory prediction, ATC-ATC exchanges, ATC-NM exchanges, flight correlation, SSR code management, flight plan correction, performance management.
Sequencing	Arrival management, departure management, integrated AMAN-DMAN, time-based separation.
Separation management	Tactical controller tools, conflict detection, conflict resolution and assistance, what if - what else probing, adherence monitoring (CLAM, RAM, …), merging and spacing.
Local ATFCM	Local demand and capacity balancing (DCB), complexity management.
Safety nets	Short term conflict alert (STCA), minimum safe altitude warning (MSAW), area proximity warning (APW), approach path monitoring (APM), ground safety nets.
Navigation	Navigation signal, performance monitoring.
Communication	Ground-ground voice communication, air-ground voice communication, voice control distribution, voice control management, performance monitoring.
Surveillance	Surveillance data fusion, tracking, surveillance data distribution, surveillance sensors, performance monitoring.
Datalink	Controller pilot datalink communication (CPDLC), automatic dependent surveillance – contract (ADS-C) including extended projected profile (EPP), context management, downlinked aircraft parameters (DAP) including humidity.
Environment (CO2/non-CO2)	CO2, non-CO2 including contrail management, noise.
CIV/MIL Airspace management	Airspace reservation management (ARES), booking management, airspace configuration and distribution, airspace status distribution.
Operational supervision	Sector configuration, configuration of parameters, operational supervision distribution
CNS infrastructure and basic services	Deployment, recording, time synchronisation, metrics & reports, logging, voice over internet protocol (VoIP), monitoring, billing.

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Network services[2]	Pan European network service (PENS), ATS common datalink services (ACDLS), future communications infrastructure (FCI), system-wide information management (SWIM) yellow profile.
Simulation, training & analysis services	Traffic generator, preparation and execution, pseudo-pilots, replay.
Meteorology	OPMET, local weather, convection, winds, clear air turbulence, icing, space weather.
Aeronautical information management (AIM)	Aeronautical information publication (AIP), aeronautical information circular (AIC), NOTAM, D-NOTAM, AIM on request, charting, charting on request.

Table 2 Level 1 Services

The business services defined in the ATM Master Plan are further subdivided into Level 2 services to provide a more granular mapping. The Task Force agreed that U-space + HAO airspace management L2 services should be categorised under a new L1 Business Service as the U2, U3, and U4 phases are rolled out, and higher airspace operations expand over Europe. However this should be addressed in a next revision of the ATM Master Plan. At the moment, the best option is to categorise them under the CIV/MIL Airspace management L1 business service.

4.2 Level 2 Services

In this document, L2 services are understood as ATM data services defined in terms of high-level core functionality, interfaces, and non-functional requirements.

4.2.1 Steering principles for the service breakdown

The following steering principles to achieve the breakdown were discussed and agreed on by the Task Force.

4.2.1.1 Guidance on granularity and grouping of services

Take away: In Enterprise Architecture design, balancing attractive and repulsive forces is crucial for determining the appropriate level of decomposition and granularity. Attractive forces favour coarse granularity for efficiency and simplicity, but can lead to inflexible monolithic systems, while repulsive forces advocate finer granularity for autonomy and fast deployment, risking excessive interdependencies and performance issues.

[2] Note that in section 4.2 there is no breakdown of the network services, as these services are not part of the typical ACC, i.e. they are out of scope of the work performed by the TF.

To address these challenges, a standard decomposition of Level 1 into Level 2 services is defined, emphasizing on separation of concerns, data ownership, service boundaries, high cohesion, and low coupling to ensure flexibility, interoperability, performance and scalability in a multi-vendor environment, while avoiding distributed transactions and minimising unnecessary inter-service communications.

Finding the correct level of decomposition and granularity of a solution is one of the most important and challenging tasks in design activities.

There are always two opposing forces in Enterprise Architecture: repulsive forces and attractive forces. The Enterprise Architecture Designer is always searching for a balance between these forces.

The attractive forces lead to have course granularity privilege factor like:

- simple and efficient interaction
- manage internal transaction

The attractive forces, without proper control, however, tend to build system with bigger component that could lead to monolith with inflexibility in evolution, maintenance and development.

The repulsive forces lead to have finer granularity, privileging factors like:

- simple smaller services and component with specific function allocated
- team autonomy with fast deployment pipeline

The repulsive force, without proper control, could lead to have too many and too tiny services with many interdependencies that may have an impact on efficiency and performance.

As the number of services and components grows, integration complexity increases, requiring more automation. More components might also lead to have distributed transaction that requires specific coordination among the services to guarantee data consistency.

To achieve the objective of accelerating the pace of development and deployment of innovation in Europe, and to facilitate the implementation of SDO8, a definition of Level 1 and Level 2 services is proposed to be performed as envisioned in the ATM Master Plan.

The level of granularity that is expected to be achieved in the service decomposition will correspond to a trade-off between avoiding a monolithic design and minimising the dependencies and coupling between different proposed services, ensuring a clear separation on the data managed by each of them.

The definition of L2 services will imply the logical level decomposition of existing and future ATM capabilities. This decomposition will ensure the flexibility required in a multi-vendor environment until the expected level of interoperability is reached. The design of the L2 services enables the realisation of the most demanding Virtual Centre architecture, which is the triangle architecture, and include a mapping with its envisaged Virtual Centre services. The proposed L2 services must consequently provide the Virtual Centre interfaces required to decouple equipment deployed at ATSU and ADSP facilities.

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The following criteria have been considered to propose a credible and optimised decomposition that will enable the realisation of the expected objectives envisioned by the SDO8:

- **Separation of concerns:** a design principle for breaking down an application into modules, layers, and encapsulations, the roles of which are independent of one another. In a multi-vendor context, it is important to manage dependencies between data flows loosely coupled between different L2 service for data integrity purposes. Each "concern" will correspond to a clear and independent business functionality minimising dependency between different services.

- **Data ownership:** only one owner for each data element as a single source of truth. If, for performance reasons, a copy of some data is needed, then only a read-only copy should be made available. Each L2 service is responsible for its own private internal data state. Eventual changes on the internal data schema for one L2 service will happen in isolation from other L2 services, ensuring that this approach eliminates design-time coupling between L2 services.

  Each internal data state will be only directly accessible by its owning L2 service. When another L2 service needs access, it will go through the interfaces exposed by the owning L2 service.

- **Data service boundaries:** L2 services must be self-contained, independent and autonomous. It is important to maintain transactions within the boundaries of L2 services since data distributed across multiple independent internal states may become inconsistent[3]. For the same reason, synchronous transactions across L2 services will create dependencies and should be carefully thought out/minimised.

  As a result, L2 services decomposition must ensure that distributed transactions across other L2 services are avoided.

- **High cohesion / Low coupling:** service decomposition must minimise coupling between L2 services and maximise cohesion within each L2 service.

  High cohesion means that the code for same related business functionality should be close to each other. The different elements of one module should remain together and accomplish one single and specific goal.

  Low coupling indicates that each module should have as few dependencies as feasible and that modifying one module should have very limited or no influence on other modules. Keeping the code loosely coupled enables that each module can be easily reused and updated at its own pace.

[3] Distributed application architectures do not inherently enforce data consistency, and a single logical transaction may span multiple services and their associated databases.

Therefore, transactions can be divided into a series of sequential local transactions on each service that must be coordinated, and fault tolerance must be considered on each step of the corresponding workflow. There are two main ways to coordinate distributed transactions: orchestration and choreography. Both approaches introduce complexities that are extremely difficult to manage with L2 services developed independently from different vendors.

Services frequently require information from multiple sources leading to inter-services communications. Optimisation is required to minimise the unnecessary communications and the amount of data shared, i.e. data exchanges must be limited to the needs of the consumer services.

For example, service types as per Virtual Centre concept (i.e. Management vs Distribution interfaces) are normally tightly coupled and should be linked within a single conceptual L2 service. It is important to note also that distribution interfaces would include different Message Exchange Patterns (e.g. publish-subscribe, request-reply).

- **Performance, including scalability**: it is of upmost importance to ensure that the L2 service performance will be meeting the very demanding user expectations in terms of capacity, response times and resources consumption. The L2 services decomposition is envisaged to provide a better scalability to manage future capacity increases. The overhead of serialising/deserialising data and sending the information across the network may have a noticeable impact on performance in certain cases and should be considered for the proposed L2 services decomposition.

The following principles were considered as NOT relevant for the L2 services decomposition:

- Common vs Specific behaviour: The difference between common and specific is not relevant for the breakdown of the services, but a challenge on the implementation to cope with the different procedures.
- Safety criteria are not directly relevant for evaluating service decomposition because safety is a system-wide, emergent property that depends on the interaction and control of multiple services, not the internal structure of individual services. Decomposition focuses on technical aspects like cohesion, coupling, and maintainability, while safety is assured through requirements traceability, unitary and system-level testing, redundancy, and fail-safe mechanisms.
- Pace layering. Even though pace layering is required for the prioritisation in the European ATM service roadmap (see companion document), it is not contributing to the development of the breakdown itself.

The Task Force discussed the need to distinguish different operational contexts (low/medium/high density, low/medium/high complexity) and levels of performance required against the different environments. The conclusion was that a L2 service needs to be dimensioned (and certified) to the most stringent environment (the peak). This is also a prerequisite to enable scaling up in Europe (and shifting traffic from one sector/FIR to another). As a result, the consideration of different levels of performance would unnecessarily bring complexity.

4.2.1.2 Balancing interoperability versus flexibility

Take away: Finding the right balance between fostering innovation and ensuring core ATM functionalities is a key consideration for the L2 services breakdown identification.

The objective of this section is the identify what is the appropriate level of definition for L2 services, so that the service breakdown will be comprehensive enough to cover the typical ATM capabilities to

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support ANSP operations, without being overly prescriptive. This will enable different industry suppliers to seek for innovation, differentiate from each other and provide added value to their customers.

Indeed, standardised frameworks can provide a foundation for innovation. Standards allow for flexibility, enabling developers to create unique and differentiated service offerings within the defined framework. However, over prescriptive or detailed standardisation of software components or services would greatly constraint innovation and competitiveness of industry solutions.

The two main concepts to strike the right balance are “interoperability” and “flexibility”, and the final objective is to balance the interoperability between L2 services with the flexibility for innovation and ANSP operation within a well-defined architecture.

Interoperability between L2 services can be defined as the capability to communicate and exchange information meaningfully and accurately to produce useful results for all involved L2 services. The content of the information exchange must be well-defined according to a common reference model.

Flexibility for L2 services is referring to the capability to allow each industry supplier to create innovative solutions providing added value functionalities.

The proposed approach for defining L2 services should follow a standardised service-oriented architecture with well-defined open interfaces, balancing innovation and flexibility with interoperability for efficient data exchange, and decoupling service and infrastructure layers following Cloud native computing principles.

The focus on the standardisation process should be on defining the core functionalities for the identified L2 services while still allowing innovation on added value functionalities and extensions that can be tailored to specific operational needs. This approach will need to ensure that innovation flourishes while maintaining compatibility with existing services.

4.2.2 Considerations about scope (services for Area Control Centres and beyond)

The work of the Task Force was exhaustive regarding the decomposition of L1 services into L2 services for Area Control Centres.

In performing the decomposition, some services for TMAs were also discussed and considered, e.g. the ground safety nets as part of the L1 safety nets business service.

However, the taxonomy may not be exhaustive for TMAs and will need further work.

4.2.3 Level 2 services taxonomy

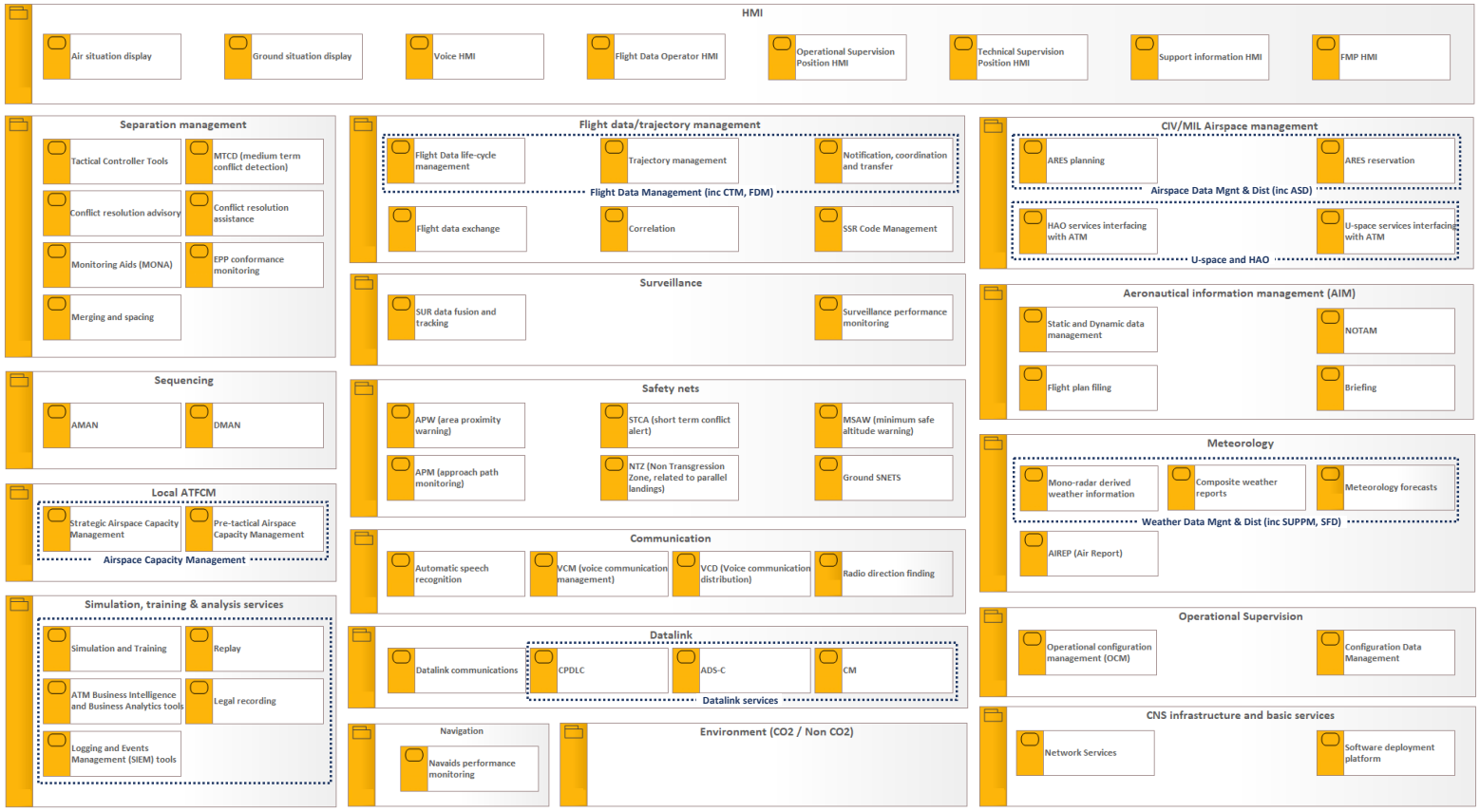


Figure 4 Taxonomy of Level 2 Services (June 2025)

The level 2 services are grouped by the 18 L1 business services described in the previous section.

The defined L2 Services are further detailed in Appendix D.

This constitutes the **minimal** breakdown[4] into L2 services as defined by the Task Force.

4.2.4 Considerations about Cost Benefit analyses

The L2 services in dashed squares of Figure 4 are subjected to further individual Cost Benefit analyses, as the costs and potential degradation of performance or resilience implied by the breakdown versus the gains in performance, scalability, reusability and resilience would depend on the design of the current industry ATM solutions.

Those services subjected to further individual Cost Benefit analyses are:

- Flight Data Management;
- Datalink services;
- Airspace Data Management & Distribution (incl. ASD);
- U-space and HAO;
- Weather Data Management & Distribution; and
- Airspace Capacity Management.

Detailed justifications are provided in Appendix D.

In any case, the overall breakdown, including the L2 services potentially subject to CBA, is the first step to be reached in Europe for 2035 to support the implementation of SDO8 in Europe by 2035 .

4.2.5 Considerations about pace layering

[4] Early 2025, DFS shared with the Task Force a decomposition of the L1 Flight/trajectory Business service into the following L2 services: SSR Code Management, Flight Progress Monitoring, Trajectory Prediction, Route Calculation, Constraint Management, Trajectory Management, (Airspace) Sector Crossing Calculator, Correlation, (Incoming) External Message Processing , (Outgoing) External Message Processing, FDPS Flight Plan Lifecycle Management, Search, FPL Alerts Calculation, Event Detector, and Coordination & Transfer.

During the ATM Master Plan revision 2023-2024 campaign, the Working Group 3 conducted an initial pace layering assessment by expert judgment to sort the different level 2 services in three categories:

- Service with highest innovation opportunities,
- Service with higher innovation opportunities,
- Service with low innovation opportunities.

Six months later, the Service Delivery Model Task force considered this input, and analysed further the pace layering through a high-level impact assessment of the ATM MP Strategic Deployment Objectives on each level 2 service. Each time an SDO impacts a given L2 service, its score is augmented by 1, resulting in a range from 0 to 12. This range was then aligned with the categories mentioned above in the following way:

- 7 ≤ Score ≤ 12: Service with highest innovation opportunities,
- 4 ≤ Score ≤ 6: Service with higher innovation opportunities,
- 0 ≤ Score ≤ 3: Service with low innovation opportunities.

In the Table 25 of Appendix E, the assessment by expert judgment is reported in the column “Outcome of ATM MP WG3 July 2024” while the Task Force analysis is recorded in the column “Outcome of TF SDM (based on ATM MP SDO)”.

Following conclusions can be drawn:

- Both columns show a relative alignment between expert judgment and ATM MP SDO impact assessment.
- The HMI L1 service exhibits a high potential for innovation and high impact from SDOs and should be decoupled as much as possible. This will be fulfilled by ATSP/ADSP separation, splitting HMI into L2 services as is proposed, to extract UX interactions as much as possible.
- In the Flight data/trajectory L1 service, the flight data management shows higher potential for innovation; it should be decoupled and may benefit from being further split into the trajectory management, since a finer analysis shows multiple impacts of SDO on the trajectory prediction module, mostly linked to the Trajectory Based Operations concept.
- Civil/military airspace management and local air traffic flow and capacity management (ATFCM) show high potentials as well. However, the current political context may restrain the potential of dynamic airspace management.

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- Innovation in Separation management shows good potential, with the restriction that involved functions are subject to higher safety criticality.
- Arrival management shows also a good potential, with the SWIM AMAN service being already standardised. It has probably the greatest cardinality of all L2 services, and so every innovation brought in will get a region-wide impact.
- Datalink services can still be quite an innovative area, with complex clearances and enhanced air-ground automation. This potential needs however to be unlocked by a higher bandwidth and resilience at the level of the Future Communication Infrastructure (FCI).
- Other areas show stability and rather low potential for innovation.

4.3 What this means for your ACC

This section describes five common target configurations in Europe. While these are standard setups, there may be other variations due to existing systems, partnerships, procurement or rollout strategies, and available market solutions.

Overall, the objective is to deploy and run for your ACC the service-oriented architecture depicting service flows that was first ambitioned in the Airspace Architecture Study [2] as follows:

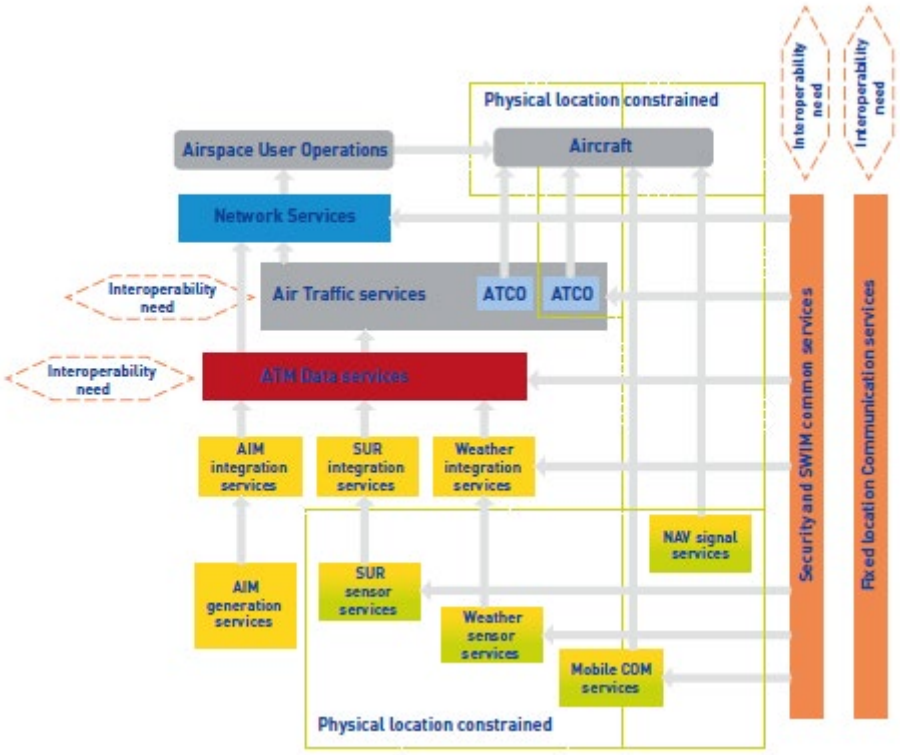
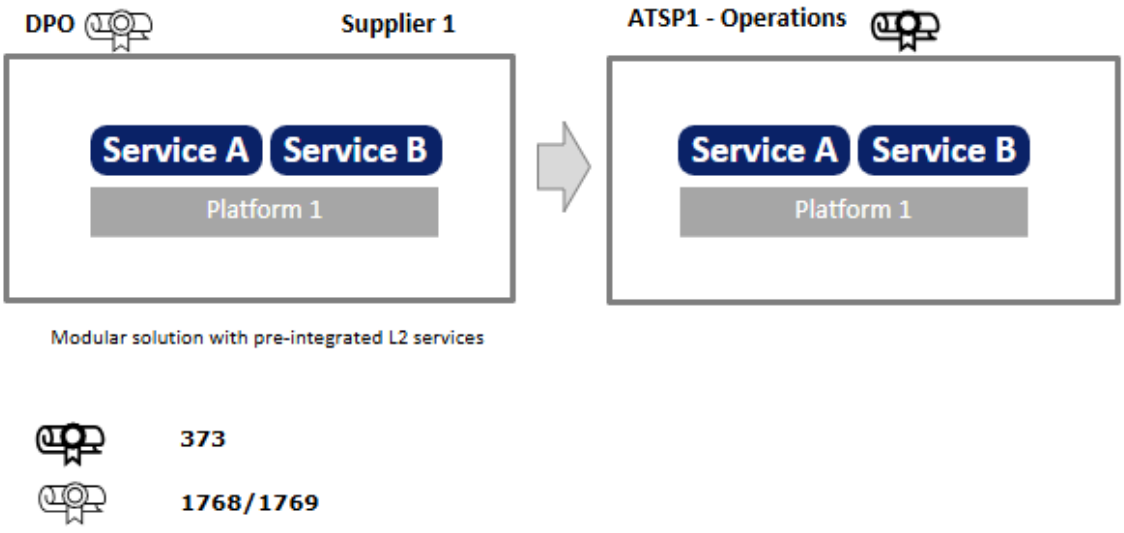


Figure 5 Service-oriented architecture ambitioned in the Airspace Architecture Study

4.3.1 Typical configuration 1



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Figure 6 Typical configuration 1

In the configuration 1, the Service A and Service B are provided by one DPO, e.g., Supplier 1. The DPO has already pre-integrated Service A, Service B on top of the software deployment platform 1. There is no need for a technical integrator[5]. This example is similar to how ANSPs are obtaining services today, with the difference that Service A and Service B are modular, interoperable and portable services with standardised SWIM interfaces.

If this configuration encompasses the full range of L2 services for a typical ACC, then this solution is a turnkey solution.

Area	Description
Scope of Procurement	ATSP procures only from one party. In this case from a DPO.
Scope of Integration	The DPO offers an integrated solution for Service A and Service B.
Benefits / limitations	The ATSP obtains services from only one party, which makes the service integration, contracting and operations easy. However, the procurement strategy may not fully benefit from the competition on services, and latest innovation brought by other suppliers.

Table 3 Typical configuration 1

4.3.2 Typical configuration 2

[5] For more considerations about the role of the technical integrator, please see the companion document, section 3.4.6.

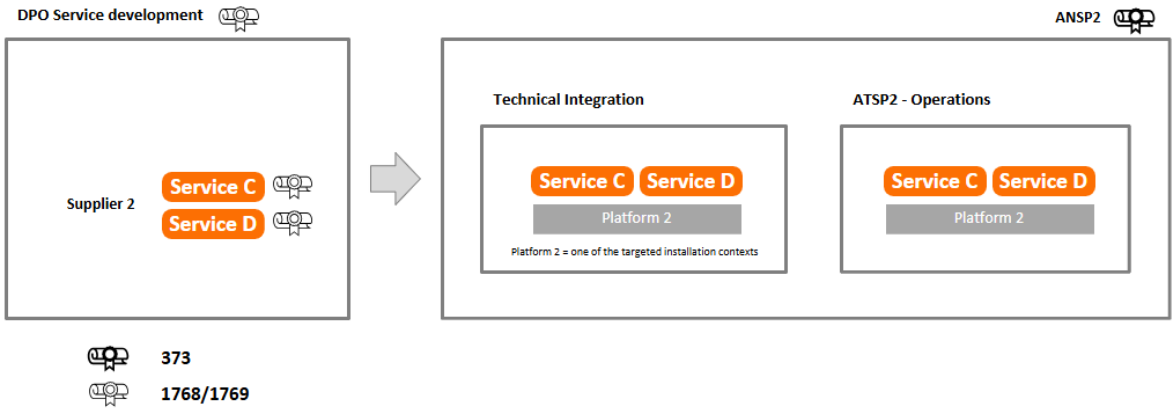


Figure 7 Typical configuration 2

In the configuration 2, the Service A and Service B are provided by one DPO, e.g., Supplier 2. The DPO offers Service A and Service B as two separated services, which need to be integrated. In this case, the ANSP2 has technical integration capabilities and performs the integration on its own.

Area	Description
Scope of Procurement	ANSP procures only from one party. In this case from a DPO.
Scope of Integration	The ANSP has service integration capabilities and performs the service integration inhouse. Integration with the platform must comply against requirements set by the DPO on the services C and D (targeted installation contexts).
Benefits / limitations	The ANSP purchases services (software components) from only one party but is now responsible for fulfilling overall functional and performance requirements. However, the procurement strategy may not fully benefit from the competition on services, and latest innovation brought by other suppliers.

Table 4 Typical configuration 2

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4.3.3 Typical configuration 3

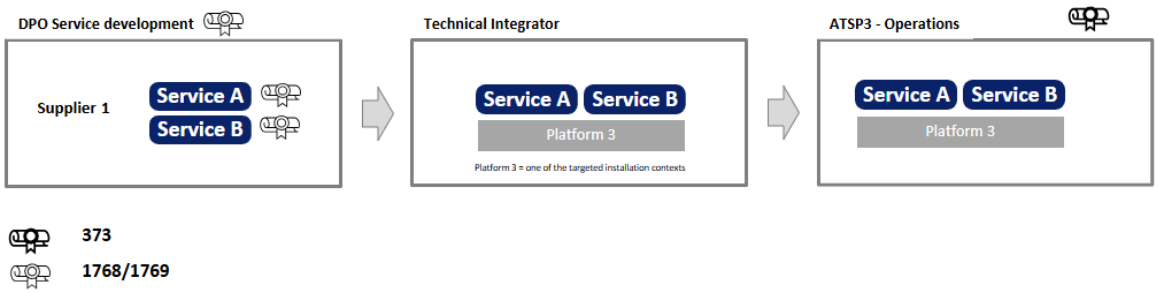


Figure 8 Typical configuration 3

In the configuration 3, the Service A and Service B are again provided by one DPO as software components, e.g. Supplier 1. The DPO offers Service A and Service B as two separated services, which need to be integrated. In this case, the integration is provided by a separate Technical Integrator, subcontracted by ATSP3, over a platform that must comply with the requirements set by the DPO on services A and B.

Area	Description
Scope of Procurement	The ATSP procures the integration of Service A, Service B over the deployment platform of the ATSP. The Technical Integrator may also typically provide solutions for Service Operation and Application Management Services.
Scope of Integration	The ANSP does not have service integration capabilities and subcontracts the service integration to a Technical Integrator. Integration with the platform must comply against requirements set by the DPO on the services A and B (targeted installation contexts).
Benefits / limitations	The ANSP delegates the integration to an integrator and can focus on its core business, Air Traffic Services. It remains responsible for the overall safety and compliance of the integrated solution. However, the procurement strategy may not fully benefit from the competition on services, and latest innovation brought by other suppliers.

Table 5 Typical configuration 3

4.3.4 Typical configuration 4

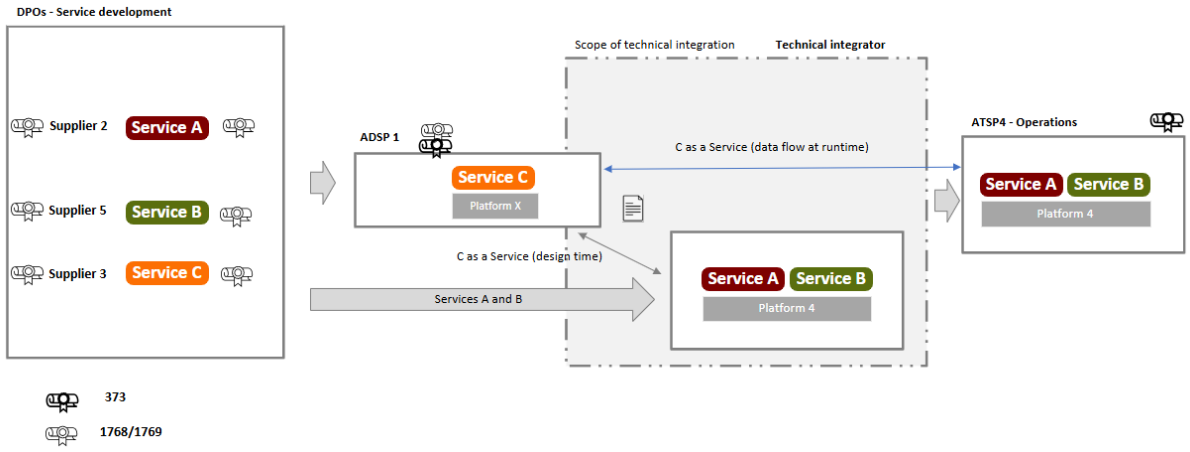


Figure 9 Typical configuration 4

Area	Description
Scope of Procurement	ATSP procures L2 services A and B from DPOs, service C from ADSP1 and technical integration from a subcontractor.
Scope of Integration	The technical integration encompasses service A, service B and platform 4. It also includes the integration of data from service C at design time. ATSP4 operates the full solution delivered by the technical integrator which consumes data from ADSP1 round the clock.
Benefits / limitations	ATSP4 benefits from the latest innovations on services. It has a very portable model since there is no or little adherence between services and platforms. Decoupling is maximal.

Table 6 Typical configuration 4

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4.3.5 Typical configuration 5

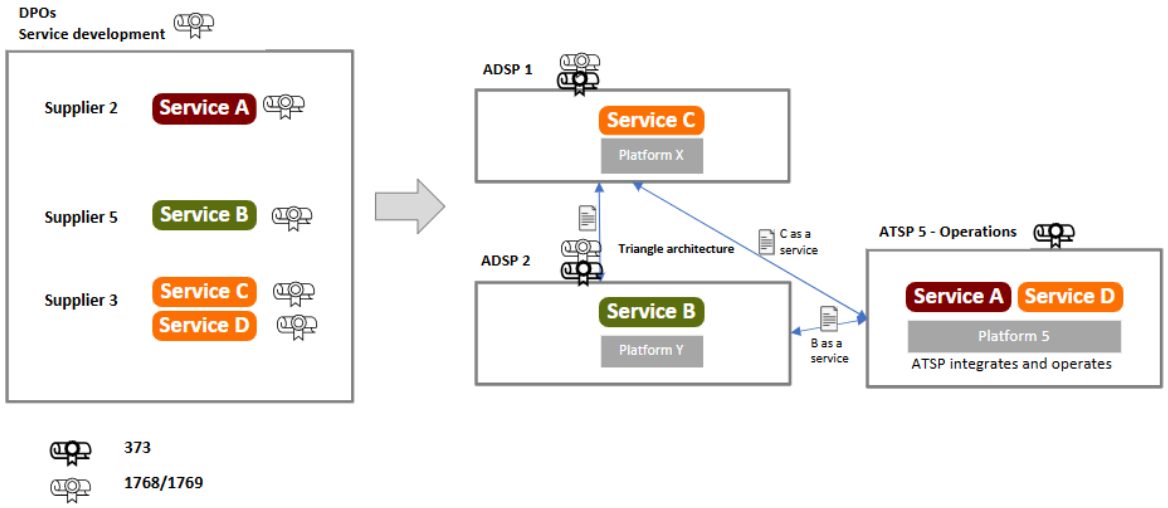


Figure 10 Typical configuration 5

Area	Description
Scope of Procurement	ATSP5 procures L2 services A and D from DPOs, services B from ADSP2 and C from ADSP1.
Scope of Integration	ATSP5 has sufficient and skilled internal staff to perform the integration of services A and D onto the platform 5, and data integration of services B and C from specialised ADSPs 1 and 2. It does not use any technical integrator. Services B and C correspond e.g. to AMAN as a service and Conflict Detection as a service.
Benefits / limitations	This configuration realises the full scope of ATM MP SDO8 and SDO6 (virtual centres) through a triangle architecture with specialised ADSPs. With a model relying on the consumption of ATM data services, ATSP5 masters its costs. Services A and D are HMI-related and the only ones ATSP5 runs in the ATSU. It benefits quickly from the latest innovation roadmaps from the ADSPs, flexibility and scalability. ADSPs are stimulated to innovate through a level playing field competition. ATSP5 experiences a major shift from CAPEX to OPEX.

Table 7 Typical configuration 5

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5 What it looks like in practice: a day in the life of an ACC with SDO8 implemented

06:00 UTC. A new day begins at an ACC. Traffic looks manageable, but convective weather is building along the western FIR boundary. No alarm bells. The Local ATFCM service (L2.07), hosted locally by the ANSP, has already rebalanced sector load. The Trajectory Management service (L2.04), provided remotely by an ADSP but integrated into the ANSP's system, is feeding updated 4D profiles to planning positions. The supervisor is still fully in charge, supported by a responsive set of modular services tuned to the day's evolving conditions.

Overnight, a new version of the Tactical Controller Tools service (L2.06), which supports conflict detection and resolution, was deployed onto the two ANSP's certified private cloud-based Software Deployment Platforms (L2.15) for security reasons. The two geographically separated platforms ensure the required resilience. One platform can takeover in the unlikely event of natural disasters. The update, developed by a DPO and validated by the contracted technical integrator, recently passed intensive automated regression checks. The deployment of this minor upgrade was seamless: no downtime, no re-training. "A nice example of continuous integration", Linda said to herself. In charge of Validation & Verification at the ATSP's Headquarters for a couple of years she could likewise measure how much the mean time to operations of major upgrades for a safety critical component has decreased from once every three or four years to twice a year in her organisation.

By mid-morning, inter-centre traffic intensifies. The Flight Data Exchange service (L2.03), provided as a service by the ADSP, automatically manages coordination with the neighbouring ACC, using rules and filters governed by the ANSP. Human override remains available but is rarely required.

Throughout the day, the ATSP's supervision team monitors system behaviour: timing, data flow, service states, and fault detection. It ensures that the full chain of services from Surveillance Data Fusion (L2.10) to Voice Communication Management (L2.09) is synchronised, verifiable, and safe. No external provider can modify live configurations. All operational assurance and responsibility remain with the ANSP.

At midday, the traffic load attains a peak, as predicted and softened by Capacity and Airspace Management Services. The services have dynamically managed the configuration of sectors. To absorb the computation load, the system scales up the trajectory computation capacity of the Separation Management service (L2.06) a service delivered remotely by a certified ADSP, but within an installation context defined and controlled by the ANSP. The integration is frictionless, using certified and standardised interfaces maintained under contractual SLAs. At night, scaling down is automated according to predefined validated scenarios to cut energy costs and CO_2 emissions. Overall, the new architecture has allowed to halve yearly energy costs and emissions.

Later in the day, a discrepancy appears in the Weather Data Management & Distribution service (L2.17). The ADSP flags the anomaly, re-routes the data stream to a fallback path, and notifies the supervisor, all automatically. Operations continue unimpeded.

At every step, the ANSP is the orchestrator. Making the key decisions, defining operational rules, owning procurement timelines, and retaining accountability. What has changed is not their role, but the architecture: now modular, scalable, and assured, with performance and resilience by design.

Appendix A References

[1] ATM Masterplan 2025, https://www.sesarju.eu/masterplan

[2] Airspace Architecture Study, https://www.sesarju.eu/sites/default/files/2019-05/AAS_FINAL_0.pdf

[3] EUROCAE report ER-026 'Virtual Centre – Strategy for Standardisation – Phase 1 (Jan 2022)' https://www.eurocae.net/product/er-026-virtual-centre-standardisation/

[4] EUROCAE report ER-029 'Taxonomy of Services for Virtual Centres (Jan 2024)' https://www.eurocae.net/product/er-029-taxonomy-of-services-for-virtual-centres/

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Appendix B Acronyms

Acronym	Description
ACC	Area Control Centre
ADSP	ATM Data Service Provider
ANSP	Air Navigation Service Provider
ATC	Air Traffic Control
ATCO	Air Traffic Controller
ATSP	Air Traffic Service Provider
ATSEP	Air Traffic Safety Electronic Personnel
ATM	Air Traffic Management
ATM MP	ATM Master Plan
ATSU	Air Traffic Service Unit
APP	Approach (Control Centre)
CAPEX	Capital Expenditure
CEO	Chief Executive Officer
CI / CD	continuous Integration / Continuous Deployment
CTO	Chief Technology Officer
DPO	Design or Production Organisation
EASA	European Union Aviation Safety Agency
HMI	Human Machine Interface
NDOPS	The Network Directors of Operations
NDTECH	Network Directors of Technology
ODA	Open Digital Architecture
OPEX	Operating Expenses
SDM	Service Delivery Model
SOA	Service Oriented Architecture
TF	Task Force
VC	Virtual Centre
WG	Working Group (EUROCAE)

Table 8 List of acronyms

Appendix C Definitions

Definitions

Term	Definition	Example
ADSP	Mimicking Article 2 of SES (2+-recast) para 4 about 'air navigation service provider' (means a public or private entity providing one or more air navigation services for general air traffic) the Service Delivery Model Task Force proposes: **ATM data service provider (ADSP) means a public or private entity providing one or more Air traffic data services to one or more ATSUs (primarily).**	
ATM data service	Pursuant to Regulation (EU) 2024/2803 (SES RECAST) • (EU) 2024/2803 (SES RECAST), para 7: 'air traffic data services' or 'ADS' means services consisting in the collection, aggregation and integration of operational data from providers of surveillance services, from providers of MET and AIS and network functions and from other relevant entities generating operational data, and the provision of processed data for air traffic control and air traffic management purposes. • Recital 28: Air traffic service providers may procure […] air traffic data services (ADS) • Article 57: Amendments to Regulation (EU) 2018/1139, para 7 related to Annex VIII introduce requirements as regards air traffic data services as regards performance in terms of availability, integrity, continuity and timeliness, quality and completeness, security as well as design, production and maintenance of the systems providing those data Airspace Architecture study also provides for the following additional details: The ATM data services provide the data and applications required to provide ATS and include flight data processing functions like flight correlation, trajectory	

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	prediction, conflict detection and conflict resolution, and arrival management planning. Presentation by the Commission on the results of the ADSP study: • ATM data services provide ANSPs/AUs/Airports with information on the intended movement of each aircraft, or variations therefrom, and with current information on the actual progress of each aircraft, based on operational data received from Surveillance, AIS, MET, network functions and any other relevant operational data. • ATM data services also provide decision advisory services to ATSUs based on advanced data processing and transformation technologies (machine learning, AI, etc.) • An ATM data service provider may or may not provide subsets of the above defined services/information. Boundary considerations for the service: • The boundary between ATM data services and Air Traffic Services is defined at the point where the data / information / application is presented on the screens of the controller working positions The boundary between ATM data services and data production is initially defined at the point where operational data enters the surveillance data processing systems (trackers) or the flight data processing systems or the more advanced tools (applications)	
Open Digital Architecture	The main principles of an Open Digital Architecture are: 1. Modularity: Each module will be specified to provide a tightly defined and cohesive sub-set of functionalities that is loosely coupled and can be used alone or in combination. 2. Services Based: The modules have publicly described interfaces based upon the exchange of	

	information and services using open data structures. 3. Technology Independent: to allow sharing of business functions throughout an organisation, the logical architecture and open interfaces will be defined independent of the technologies used to implement and integrate them. 4. Data Centric: data provide the primary definition of the system's known world and is independent of any module's specific behaviour. A module can change data or respond to a change in data. As such data is true at any instance or location and can therefore be useful to many processes. To that effect, data must be discoverable, reachable and consumable. 5. Layered Approach: applications are structured in layers; in-between each layer are well-defined interfaces that isolate a layer from the one above it and one below. A change to an application in one layer can be made without impacting another application in any of the other layers thus allowing the layers to evolve independently. 6. Incremental: It is important to recognise the already significant and recent investment in legacy technology. Old systems and new systems need to live together and most importantly need to be interoperable (able to communicate important business data with each another).	
Platform as a Service	Platform as a service (PaaS) is a type of cloud offering that delivers application infrastructure (middleware) capabilities as a service. Source: https://www.gartner.com/en/information-technology/glossary/platform-as-a-service-paas	STCA - platform is delivered by the provider for the consumer to install its STCA application or service
Productification	Capability to propose common products or services across Europe with little or no customisation.	
Software integration	Software integration is defined as the process of linking different computing systems and software applications physically or functionally together to act as a coordinated whole.	STCA (application) - artefact delivered to be integrated into

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	Alternative: Application integration is the process of enabling independently designed applications to work together. Commonly required capabilities include: • Keeping separate copies of data (in independently designed applications) consistent • Orchestrating the integrated flow of multiple activities performed by disparate applications • Providing access to data and functionality from independently designed applications through what appears to be a single user interface or application service Source: https://www.gartner.com/en/information-technology/glossary/application-integration	consumer system / platform
Software as a service	Software as a service (SaaS) is software that is owned, delivered and managed remotely by one or more providers. The provider delivers software based on one set of common code and data definitions that is consumed in a one-to-many model by all contracted customers at any time on a pay-for-use basis or as a subscription based on use metrics. Source: https://www.gartner.com/en/information-technology/glossary/software-as-a-service-saas	STCA (service) - service provided where outcome of the service is delivered to the customer and application is running on a provider platform
Targeted installation contexts	Contexts of installation specified, validated and documented by a DPO in the certificate of an ATM/ANS equipment.	

Definitions from EC regulations

Source	Item	Definition
2017/373	Data services provider	An organisation, which is: a) type 1 DAT provider that processes aeronautical data for use on aircraft and provides an aeronautical database meeting the DQRs, under controlled conditions, for which no corresponding

		airborne application/equipment compatibility has been determined. b) type 2 DAT provider that processes aeronautical data and provides an aeronautical database for use on certified aircraft application/equipment meeting the DQRs for which compatibility with that application/equipment has been determined.
2018/1139	ATM/ANS constituent	Tangible objects such as hardware and intangible objects such as software upon which the interoperability of the EATMN depends
2018/1139	ATM/ANS system	The aggregation of airborne and ground-based constituents, as well as space-based equipment, that provides support for air navigation services for all phases of flight;
2018/1139	Certification	Any form of recognition in accordance with this Regulation, based on an appropriate assessment, that a legal or natural person, product, part, non-installed equipment, equipment to control unmanned aircraft remotely, aerodrome, safety-related aerodrome equipment, ATM/ANS system, ATM/ANS constituent or flight simulation training device complies with the applicable requirements of this Regulation and of the delegated and implementing acts adopted on the basis thereof, through the issuance of a certificate attesting such compliance;
2018/1139	Declaration	Any written statement made in accordance with this Regulation under the sole responsibility of a legal or natural person subject to this Regulation and which confirms that the applicable requirements of this Regulation and of the delegated and implementing acts adopted on the basis thereof relating to a legal or natural person, product, part, non-installed equipment, equipment to control unmanned aircraft remotely, safety-related aerodrome equipment, ATM/ANS system, ATM/ANS constituent or flight simulation training device are complied with;
2023/1768	ATM/ANS equipment	ATM/ANS constituents as defined by Article 3(6) of Regulation (EU) 2018/1139 and ATM/ANS

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		systems as defined by Article 3(7) of that Regulation, excluding airborne constituents, which are subject to Commission Regulation (EU) No 748/2012
2023/1768	Functional system	A combination of procedures, human resources and equipment, including hardware and software, organised to perform a function within the context of ATM/ANS and other ATM network functions.
2024/2803 (SES 2+)	Air navigation services (ANS)	Air traffic services: communication, navigation and surveillance services (CNS) including services which augment signals emitted by satellites of core constellations of GNSS for the purpose of air navigation; meteorological services for air navigation (MET); aeronautical information services (AIS); **and air traffic data services (ADS);**
2024/2803 (SES 2+)	Air traffic Data Services (ADS)	Services consisting in the collection, aggregation and integration of operational data from providers of surveillance services, from providers of MET and AIS and network functions and from other relevant entities generating operational data, and the provision of processed data for air traffic control and air traffic management purposes
2024/2803 (SES 2+)	SESAR solution	A deployable output of the SESAR development phase introducing new or improved standardised and interoperable operational procedures or technologies

Definitions from PANS-Information Management (ICAO Document 10199)

Item	Definition
Data	A representation of facts, concepts or instructions in a formalized manner suitable for communication, interpretation or processing.
Exchange schema	Formal description of the data involved in an information exchange, including, in particular, the encodings and other applicable constraints.

	Note.— An exchange schema assists information service consumers in understanding the syntax of the data delivered by the information service, and the technologies required for locally processing the data received. An exchange schema is based on a data exchange language which is standardised. For example, Extensible Markup Language (XML) schema *is a World Wide Web Consortium (W3C) data exchange language used to define XML encoded messages*.
Governance	The set of bodies, standards, policies and processes that ensure globally interoperable information is provided by reliable and trusted services.
Information	The result of the assembly, analysis, formatting and documenting of data, to make the data useful in an ATM context.
Information domain	The scope of the integrated data for a distinct set of business activities that produce a set of unique information products and services.
Information exchange model	A formal description of the information that is agreed to be shared between two or more organisations or groups and includes at least one exchange schema for the associated data. *Note.— An information exchange model is normally defined for a specific information domain, such as aeronautical information, meteorological information or flight information. This typically includes the definition of information entities and their relationships.*
Information security category	A categorisation of the impact on the safety of operations due to the loss of information confidentiality, integrity or availability.
Information service	A type of service in a service-oriented architecture that provides an ATM-related information-sharing capability.
Information service overview	A set of information service metadata intended to promote information service discovery and an initial evaluation of the information service characteristics.
Information service payload	The assembly of information exchanged using an information service. *Note.— Information service payloads support a specified function(s) or purpose, independent of overhead required to enable the information exchange, such as headers, and security requirements.*
Interface binding	Specification of the protocols and data formats to be used in transmitting messages defined by the associated interface.
Interoperability	The ability of information and communication technology (ICT) systems, and of the business processes they support, to exchange data and to enable the sharing of information and knowledge.

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Message	A discrete unit of communication intended by the source for consumption by a given recipient or group of recipients.
Metadata	Information about a resource. *Note.— An information service, an information service overview and a dataset are examples of resources.*
Reference model	An abstract framework for understanding significant relationships among the entities of information domains.
Service-oriented architecture	Architectural style that supports the designing of systems in terms of services and service-based development.
System-wide information management (SWIM)	Standards, infrastructure and governance enabling the management of ATM-related information and its exchange between qualified parties via interoperable information services.
System-wide information management (SWIM) region	A geographical area in which a group of States and/or ATM stakeholders has agreed upon common governance in support of regional system-wide information management implementation. *Note.— A SWIM region can be an ICAO region or any other area in which a community of interest has agreed on common governance. Communities of interest are established in a variety of ways and may be composed of members from one or more functions and organisations as needed for a shared mission.*
System-wide information management (SWIM) registry	A directory containing entries with the information (metadata) necessary to discover and access information services.
Technical infrastructure	The assembly of software and hardware used to enable the provision of information services.

Appendix D Detailed level 2 services taxonomy

D.1 HMI

Agreed L2 services	Functional description	Justification
Air situation display	Source: Service Delivery Model Task Force 'Role based displaying in an integrated air situation of the following data processed by other L2 services, typically including e.g.: - Tracks display, - Flight data display, - Alert generation service (including prioritisation of alerts), - Airspace status display - Direction finder display - electronic coordination - AMAN/DMAN information display - datalink	HMIs are split according to the main functionality; the sum of all HMIs covers all use cases, but the grouping for a particular product or ANSP use cases may be different, e.g. datalink separate from ASD/GSD. NB: NOTAM management is under AIM

Agreed L2 services	Functional description	Justification
Ground situation display	Source: Service Delivery Model Task Force - Role based displaying in an integrated ground situation of the following data processed by other L2 services, typically including e.g.: - Tracks display, - Flight data display, - Alert generation service (including prioritisation of alerts) - Airport surface safety net alerts, including runway alerts - electronic coordination - datalink	HMIs are split according to the main functionality; the sum of all HMIs covers all use cases, but the grouping for a particular product or ANSP use cases may be different, e.g. datalink separate from ASD/GSD. NB: NOTAM management is under AIM
Voice HMI	Source: Service Delivery Model Task Force HMI used by the air traffic controller to establish radio communication for air-ground communication or to establish ground/ground communications. It consumes services provided by VCD and VCM.	
Flight Data Operator HMI	Source: Service Delivery Model Task Force Provide access to all system flight plans currently managed by the system, which can be displayed via lists according to various states. Provide access to flight plans which were not successfully validated by the system and offer to the user means of correction before reprocessing Provide access to related messages linked to flight plans.	

Agreed L2 services	Functional description	Justification
Operational Supervision Position HMI	Source: adapted from SESAR ARCHITECTURE The Operational Supervision Position provides the HMI for the Operational Supervisor roles, allowing them to perform several monitoring and configuration tasks, as well as the display of relevant information such as notifications and alerts. Operational Supervisors use this user interface to manage the most appropriate operational configuration, according to traffic demands and needs, and to react in case of system fault, re-assigning and distributing available resources in order to maintain adequate safety levels and quality of service. Operational configuration data typically include e.g.: - Management of the mapping of control roles and responsibilities (control volume, ADES, set of runways,...) - Management of ATS Delegation - Radio Frequency allocation plan management - Airspace status (CDR/ARES activation) management - Viewing and modification of QNH data and the setting of default wind and temperature data - Assignment of SSR codes and code ranges - Aerodrome configuration management	HMIs are split according to the main functionality; the sum of all HMIs covers all use cases, but the grouping for a particular product or ANSP use cases may be different, e.g. datalink separate from ASD/GSD. NB: NOTAM management is under AIM

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Agreed L2 services	Functional description	Justification
Technical Supervision Position HMI	Source: adapted from SESAR ARCHITECTURE The Technical Supervision Role-based HMI is in charge of controlling and monitoring the services composing the ATM/ANS system. The Technical Supervision typically encompasses e.g.: - Present technical and functional systems status - Acquire, synthesize and display technical and functional status on all the system resources - Provide failure detection and analysis assistance - Provide CNS status, - Provide support for analysing control and monitoring data - Provide supervision commands and actions from eligible operators - Provide the capability to perform maintenance activities.	HMIs are split according to the main functionality; the sum of all HMIs covers all use cases, but the grouping for a particular product or ANSP use cases may be different, e.g. datalink separate from ASD/GSD. NB: NOTAM management is under AIM
Support information HMI	Source: Service Delivery Model Task Force HMI used to provide support information to ATCO & Supervisor roles, typically e.g.: - environment data (QNH/transition level), - airport information (e.g. runway status), - CNS status, - ATIS bulletins, - weather information, - ARR/DEP sequence, - AIM information.	

Agreed L2 services	Functional description	Justification
FMP HMI	Source: Service Delivery Model Task Force Role-based HMI supporting flow management activities. The FMP's role is, in partnership with the NM, to act in such a manner so as to provide the most effective ATFCM service to ATC and AoUs. An FMP is responsible for ensuring the local promulgation, by the appropriate means (national NOTAM, AIP, ATM operational instruction, etc.) of procedures which affect ATC Units or operators within the FMP's area. FMPs shall monitor the effectiveness of such procedures.	HMIs are split according to the main functionality; the sum of all HMIs covers all use cases, but the grouping for a particular product or ANSP use cases may be different, e.g. datalink separate from ASD/GSD. NB: NOTAM management is under AIM

Table 9 HMI Capabilities

D.2 Flight data/trajectory management

Agreed L2 services	Functional description	Justification
Flight data exchange	FDE is responsible to create the correct data exchange for all the external partners interested in Flight Data. In support of TBO exchanging of flight information (between ANSP, between ANSP and NM, or from/to other entities) in support of the following use-cases: - inter-centre coordination, negotiation and transfer. - Reception of downstream requirements and Downstream distribution of ATC flight intent ….) - CIV MIL coordination - FF-ICE/1	- Implement the protocol needed by all the partners - Close collaboration with Flight Data Management that is responsible for the functional processing of inbound/outbound data. FDE is adapting the protocol, managing subscriptions, filtering, routing, etc. - Include e.g.: OLDI/AFTN, Network TBO, ATC TBO, etc

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Agreed L2 services	Functional description	Justification
	- FF-ICE/2 - ... This data exchange excludes raw data coming from the airborne side.	
Correlation	Source adapted from SESAR ARCHITECTURE: The Correlation Management functional block correlates system tracks with flight data (SFPL) based typically on e.g. a mode 3/A code, Aircraft Identification (Mode S or ADS), 24 bit address (when available) and proximity criteria between the system track and the flight trajectory. This function is provided as individual services and assigned to the Level 1 Business Service "Flight Plan Management", not to the "Surveillance Data Processing".	Rational for that: The Correlation is only functional with Flight-Plan Data; therefore it has a stronger relation to FDP. Without SDP-Data, the whole system would not work, without FPL-Data the display of tracks is still possible without FPL-data.
SSR Code Management	Source adapted from SESAR ARCHITECTURE Performs the assignment of SSR Mode 3/A codes to any flight in the controlled airspace according to the allocation plan and the life cycle of the SSR codes (ICAO Originating Region Code Assignment Method - ORCAM or allocation by a remote central unit (CCAMS)) – question on the flight plan itself	
Flight Data Management (incl. CTM, FDM)	Source: SESAR ARCHITECTURE and adapted The Flight Data Management (FDM) service is responsible for processing and managing flight plans. It provides real-time flight information to other services and enables automated coordination between internal sectors and with adjacent air traffic control centres. The most significant capability of FDM service is the 4D trajectory calculation, which utilizes flight plan, meteorological, conformance	The TF considers that the Flight data management L2 service could be divided into 3 more services, namely the Trajectory management service, the Flight Data life-cycle management service, and the Notification, Coordination and Transfer service. A matter subject to CBA

Agreed L2 services	Functional description	Justification
	and aircraft performance data combined with airspace and supported by the ATC procedures to calculate the expected trajectory of the flight in four dimensions. Main functions provided by FDM include: • **Flight Data life-cycle management**: taking over the reception, validation and processing of (external and internal) messages (e.g. IFPS, ETFMS, TWR, AMAN, Adjacent Centres, Tactical Tools, MONA, Datalink) and inputs (e.g. CWP, FDO) related to flight plans. This covers the creation, modification and deletion of internal Flight Plans, ensuring the integrity and consistency of the flight data throughout the life cycle of the flight, including also the management of the erroneous messages queues for several interfaces • **Trajectory Management**: including the following functionalities o Route Management: extraction and modifications (due to operator inputs or airspace structure changes) o Constraint Management: including ATC strategic (airspace structure) and tactical (operator actions and clearances) constraints o Trajectory Prediction: calculating the Planned Trajectory that takes into account the planned route and requested vertical profile, strategic ATC constraints, tactical constraints and co-ordination conditions. This trajectory is computed from the flight data, the airspace and meteorological data o Sector Sequence Calculation: determining the sequence of traversed sectors (both Control and Informed, Civil and Military), including the adjacent external sectors, and the crossing with other areas/volumes of interest (e.g. TSA, holding). It provides the	There is business interest from the buyer perspective for a separate trajectory management and support from PANSA, NATS, DFS, Skyguide, DSNA,COOPANS and MUAC was recorded. The business needs for that are to reach independent lifecycles for the different level 2 services and add new functions in a more efficient and flexible way and a single source of reference across the different ATS units, at least within an ANSP. For DFS more specifically, this business need was expressed in the document DFS FDP Service Decomposition-proposal-TF-v2.xlsx. However, this is subject to a trade-off with industry, especially Indra who considers that the split may challenge the data ownership criterion (which is one of the steering principles applied to all L1 services to decide whether to break them down or not). The main two arguments discussed by the TF and recorded are that: * In an FDP, Route calculation and TP are closely related and done in sequence. First route calculation would occur, followed by a trajectory prediction. * Transaction integrity may be at risk if a roll back of all the transactions performed by different L2 services cannot be done. This is true in a context of synchronous transactions only. If asynchronous

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Agreed L2 services	Functional description	Justification
	progression list based on a subset of significant samples from the Trajectory Prediction function o Aircraft Data: Responsible for the provision of specific parameters corresponding to aircraft performances (e.g. BADA model) • **Notification, Coordination and Transfer**: supporting silent and electronic coordination between internal and external partners (including Air Defence) in a seamless way. Only in exceptional situations, when the flight cannot comply with the planned coordination conditions, the controllers will be properly warned and advised to coordinate via telephone. It processes co-ordination and transfer manual inputs and messages and determines for each flight plan the relevant co-ordination and transfer data at boundaries (i.e. between internal sectors and at entry to and exit from the AoR)	transactions are involved, then one can split services. This is therefore linked to two design options for the FDP: stateful services without orchestration, or stateless services with orchestration. The latter is more scalable and flexible. For current designs being stateful, the split can prove challenging and might require a deep rework. Failing this, the L2 service reworked may suffer a lack of performance, or even a lack of integrity, and not rise to the promise, since the new design would not be fully scalable, especially in a triangle architecture where ADSPs are specialised and remote. Other types of design may or may not justify the split and entail a positive CBA, e.g. in terms of scalability, performance, data ownership or CI/CD. It becomes therefore a matter of CBA.

Table 10 Flight data/trajectory management

D.3 Sequencing

Agreed L2 services	Functional description	Justification
AMAN	Source Skybrary and adapted Calculates optimum aircraft arrival sequences and times for flights approaching to defined constraint points considering preferred flight profiles, aircraft types, performance, and weight categories, airspace and runway conditions, inbound flow rate, as well as meteorological (MET) conditions and applying suitable optimisation criteria. AMAN comprises AMAN in the wider scope, namely extended AMAN, with a focus on the arrival sequence itself.	
DMAN	Source SESAR ARCHITECTURE and adapted Proposes a pre-departure sequence of flights on one or more airport runways – question on the flight plan, constraints, clearances and inputs including AMAN sequence; The sequence provides both TSAT and TTOT – considering taxi times and is updated according to the actual aircraft take-off.	

Table 11 Sequencing

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D.4 Separation management

Agreed L2 services	Functional description	Justification
Tactical Controller Tools	Source: Service Delivery Model Task Force, adapted from Skybrary Tools supporting the controller in checking that envisaged clearances or trajectories will not cause conflicts in the near future The typical look ahead time is up to 5-8 minutes depending on local implementation. Input: surveillance and/or FPL data and controller (what if scenario), depending on local implementation. Used as: conflict resolution verification and clearance verification tool (to inform the controller if the current clearance results in a separation breach so that it can be corrected if necessary).	Note that this is also referred to as Near-Term Conflict Alerting.
MTCD (medium term conflict detection)	Source Skybrary and adapted Medium-Term Conflict Detection (MTCD) is a flight data processing system designed to warn the controller of potential conflict between flights in his area of responsibility in a time horizon extending up to 20 minutes ahead. MTCD is an integrated system of predictive tools performing the following functions: The detection and notification to the controller of probable loss of the required separation between two aircraft; The detection and notification to the controller of aircraft penetrating segregated or otherwise restricted airspace; The detection and display to the controller of aircraft-to-aircraft encounters where, although the required separation will be achieved, each aircraft is blocking airspace that might have been used by the	

Agreed L2 services	Functional description	Justification
	other, e.g. In case of pilot request for an alternative level or when resolving a conflict involving one of the aircraft.	
Conflict resolution advisory	Source: Service Delivery Model Task Force Automated system function that assists air traffic controllers with automated suggestions to resolve trajectory efficiently and safely	
Conflict resolution assistance	Source SESAR ARCHITECTURE and adapted Provides conflict resolution assistance: by providing contextual views or resolution context by pre-analysing the conflicts of all common clearances and coordination TFLs (Transfer Flight Levels) available for any flight by automatically solving conflicts using small speed adjustments requested to the aircraft through a CTO (Controlled Time of Over-fly) taking into account the downlinked ETA (Estimated Time of Arrival) min/max	
Monitoring Aids (MONA)	Source ECTL Standard The purpose of MONA is to assist the controller in the routine monitoring of the traffic situation, warning the controller when aircraft deviate from their planned route or clearances, reminding the controller of actions that need to be performed, and keeping the trajectories updated with the progress of the flights. The document	

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Agreed L2 services	Functional description	Justification
	describes objectives to be achieved and system requirements describing a behaviour of the system that achieves the objectives.	
EPP conformance monitoring	Source SESAR ARCHITECTURE and adapted Compare EPP with ground prediction and raise alert if they are different. Alerts when an aircraft's actual position is not within the conformance region constructed around that aircraft at its position, according to the trajectory associated with the aircraft's provided EPP.	
Merging and spacing.	Source SESAR ARCHITECTURE and adapted Proposes distance or time between aircraft and hazard at or above separation minima in order to maintain a safe and orderly flow of traffic. (The application of an additional displacement to a specific separation minimum between an aircraft and a hazard). It allows merging traffic flows into determined points and is implemented through Time Based Separation (TBS) and Distance Based Separation (DBS) functionality.	

Table 12 Separation Management

D.5 Local ATFCM

Agreed L2 services	Functional description	Justification
Airspace Capacity Management	Source: Service Delivery Model Task Force The Airspace Capacity Management Service enables operational users to determine traffic levels, in a specific area of airspace within a given timeframe and use this information to dynamically manage the configuration of sectors and/or apply airspace constraints to manage this as efficiently as possible. The services also allow users to publish such sector changes to other customers, to support their own awareness and planning.	Subject to CBA if breakdown into strategic and pre-tactical is needed.

Table 13 Local ATFCM

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D.6 Safety nets

Agreed L2 services	Functional description	Justification
STCA (short term conflict alert)	Source: SESAR ARCHITECTURE (view): The short-term conflict management process relates to the management of mid-air collision hazards (involving at least one controlled flights) by air traffic controllers assisted by Short Term Conflict Alert (STCA). STCA is a ground-based safety net intended to assist the controller in preventing collision between aircraft by generating, in a timely manner, an alert of a potential or actual infringement of separation minima. The purpose of STCA is to detect and alert 'operationally relevant conflict' involving at least one 'eligible aircraft' with 'sufficient warning time' for the controller to intervene and the aircraft to execute an appropriate manoeuvre. This may be either to detect and alert on-time any of the following: predicted or actual infringement of separation minima for controlled flights (either IFR or VFR) to which ATC is expected to provide separation; hazardous encounters involving at least one controlled flight (either IFR or VFR) in situations where collision avoidance relies on visual separation by aircraft. The sole purpose of STCA is to enhance safety and its presence is ignored when calculating sector capacity. STCA is designed, configured and used to make a significant positive contribution to the effectiveness of separation provision and collision avoidance.	

Agreed L2 services	Functional description	Justification
MSAW (minimum safe altitude warning)	Source: SESAR ARCHITECTURE (objective- status "removed"): MSAW is ground based safety net is intended to warn the air traffic controller (ATCO) about the increased risk of controlled flight into terrain by generating, in a timely manner, an alert of aircraft proximity to terrain or obstacles.	
APW (area proximity warning)	Source: SESAR ARCHITECTURE (objective): Area Proximity Warning (APW) is a ground-based safety net which uses surveillance data and flight path prediction to warn the controller when an aircraft is, or is predicted to be, flying into a volume of notified airspace, such as controlled airspace, danger areas, prohibited areas and restricted areas. APW is intended to function in the short term Terrain and traffic characteristics can lead to a significant safety risk that can be mitigated by this tool. An explanation of the difference between Level 1 and 2 is described below.	

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Agreed L2 services	Functional description	Justification
APM (approach path monitoring)	Source: SESAR ARCHITECTURE (objective): An approach path monitor (APM) is a ground based Safety Net intended to warn the controller about increased risk of controlled flight into terrain accidents by generating, in a timely manner, an alert of aircraft proximity to terrain or obstacles during final approach. Terrain and traffic characteristics can lead to a significant safety risk that can be mitigated by this tool. An explanation of the difference between Level 1 and 2 is described below.	
NTZ (Non-Transgression Zone, related to parallel landings)	Source: Service Delivery Model Task Force A non-transgression zone (NTZ) alert is a ground-based Safety Net intended to assist the controller in preventing collision between aircraft by generating, in a timely manner, an alert of an actual infringement of a NTZ. An NTZ, in the context of independent parallel approaches, is a corridor of airspace of defined dimensions located centrally between the two extended runway centre lines, where a penetration by an aircraft requires a controller intervention to manoeuvre any threatened aircraft on the adjacent approach.	

Agreed L2 services	Functional description	Justification
Ground SNETS	Source: SESAR ARCHITECTURE The system detects conflicts and infringements of some ATC rules involving aircraft or vehicles on runways and provides the controller with appropriate alerts. Whereas the detection of conflicts identifies a possibility of a collision between aircraft and/or vehicles, the detection of infringements focuses on dangerous situations because one or more mobiles infringed ATC rules. This improvement addresses also incursions by an aircraft into an area where the presence of an aircraft (or vehicle) is temporarily restricted or forbidden (e.g. closed taxiway, ILS or MLS critical area).	

Table 14 Safety nets

D.7 Navigation

Agreed L2 services	Functional description	Justification
Navaids performance monitoring	Needed for both operational and technical supervision	

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D.8 Communication

Agreed L2 services	Functional description	Justification
Automatic speech recognition	Source: EUROCAE WG 126 ASR is first a service allowing to process audio communications into a readable and processable text. ASR can be completed by sub-sequent services processing the text output to provide added-value functionalities (readback check, callsign identification, safety nets)	
VCM (voice communication management)	Source SESAR ARCHITECTURE (this includes WG122 description) This service is part of the set of services primarily designed to support the Virtual Centre concept. It supports the interactions between ATM Data Service Providers (ADSP) and Virtual Centre Air Traffic Service Units (ATSUs). This service is consistent with the other services of the Virtual Centre service set. Please be aware any similarity with some other SESAR services does not necessarily make them interchangeable inside or outside this context. The Voice Communication Management allows the consumers to control the voice communication system by providing access to: - Air/Ground voice signalling functionality - Ground/Ground voice signalling functionality" The former two services are provided by the underline CNS Infrastructure and it is out of the scope of this document.	G-G Voice COM and A-G voice COM were considered as L2 services but were removed: GG Voice COM and AG Voice COM are services included the ATM /CNS Infrastructure (GeoFixed services), and it is not in the boundary of an ATC/ACC Solution.
VCD (Voice communication distribution)	Source SESAR ARCHITECTURE (that includes WG122 description) This service is part of the set of services primarily designed to support the Virtual Centre concept. It supports the interactions between ATM Data Service Providers (ADSP) and Virtual Centre Air Traffic Service Units (ATSUs). This service is consistent with the other services of the Virtual Centre service set. Please be aware any similarity with some	G-G Voice COM and A-G voice COM were considered as L2 services but were removed: GG Voice COM and AG Voice COM are services included the ATM /CNS Infrastructure (GeoFixed services), and it is not in the boundary of an ATC/ACC Solution.

Agreed L2 services	Functional description	Justification
	other SESAR services does not necessarily make them interchangeable inside or outside this context. The Voice Communication Distribution service aims at the distribution of the following information about voice communication data: - Assignment of air/ground and ground/ground voice communication resources to CWP - Voice communication status information (e.g. radio communication signalling status, phone call status, conference participants, conversation history)"	
Radio Direction Finding	Use of radio waves to determine the direction to a radio source	

Table 15 - Communication

D.9 Surveillance

Agreed L2 services	Functional description	Justification
SUR data fusion and tracking	Source: SESAR ARCHITECTURE The Surveillance functional block merges traffic data provided by surveillance sources (PSR, SSR, ADS-C for oceanic flights, ADS-B, WAM) to provide a unique, system-wide reference of the actual air traffic situation. The Surveillance functional block may also receive weather data from PSR sources. - Multi Sensor Data Fusion	

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	Furthermore, this L2-Service includes also the function of Multi Sensor Data Fusion: Definition by SESAR ARCHITECTURE: This system processes the surveillance sensor data to identify aircraft track/trajectories and provides fused track output. This L2 service may also include satellite-based ADS-B.	
Surveillance performance monitoring	Needed for both operational and technical supervision	

Table 16 Surveillance

D.10 Datalink

Agreed L2 services	Functional description	Justification
Datalink services	Source: Service Delivery Model Task Force The various (functional) services, corresponding to CPDLC, ADS-C and CM applications, supporting e.g. air/ground flight exchanges. Note that the 3 datalink applications defined in the ED-228 standard are further broken down into services. The outcome of the CBA could be a business decision (from the supplier or the buyer) that ends up with a split grouping some of the services. There is no one-on-one relationship between services defined in ED-228 that we be provided and L2 services being finally provided.	This includes ACDLS service which is a regional design choice and may not followed at global level.
Datalink communications	Source: Service Delivery Model Task Force Managing the technical link. This is an infrastructure service supporting the datalink services. This includes the gateway with ATN/FANS, and G/G BIS router.	

Table 17 Datalink

D.11 Environment (CO2/Non-CO2)

Agreed L2 services	Functional description	Justification
<< No services identified		No L2 service identified so far, but L1 business service will require data for post-operations analysis.

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Agreed L2 services	Functional description	Justification
that would require a standard and/or AMC>>		Note that some data will need to be used for environmental analysis.

Table 18 Environment (CO2/non-CO2)

D.12 CIV/MIL Airspace management

Agreed L2 services	Functional description	Justification
Airspace Data Mgmt & Dist (incl. ASD)	Source: Service Delivery Model Task Force This service supports the publication of airspace configuration updates from operational supervisor orders, based on planned and/or effective MIL activities: - updates of the airspace status (activation or deactivation of ARES/CDR) to subscribing CWP and operational supervisor consumers. ARES designates all military area types: TSA (Temporary Segregated Area), CBA (Cross Border Area), TRA (Temporary Restricted Area)... - updates of the airspace {planning (CDR/ARES timesheets) to subscribing operational supervisor consumers. These timesheets define the status of an airspace according to applicable flight level layers and an applicable period, including periodicity. This service exposes the following functions: - Provide Airspace Planning - Publish Airspace Planning	Note that dynamic RAD is out of scope for a typical ACC. Subject to CBA - LARA currently provided by ECTL, but there are other options. Some ANSPs have already split this L1 business service into different L2 services.

Agreed L2 services	Functional description	Justification
	- Provide Airspace Status - Publish Airspace Status	

Table 19 CIV/MIL Airspace management

D.13 Operational supervision

Agreed L2 services	Functional description	Justification
Operational configuration management (OCM)	Source: Service Delivery Model Task Force Includes sector configuration, combination, delegation, … Note that this scope is bigger than EUROCAE WG122, because not only linked to Virtual Centre, but e.g. runway configurations are included.	
Configuration Data Management	Source: Service Delivery Model Task Force Data defined offline and deployed as files that will be loaded by applications at startup and will be then static or modified with low frequency during runtime. Three different types of configuration data are identified: • Deployment data: Providing configuration values that the application needs at runtime and allows to adapt its behaviour to different execution environments without affecting the code or image containers. In a Kubernetes framework, this is normally provided by ConfigMaps (or Secrets) in the form of key-value pairs within YAML files. • Adaptation data:	

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Agreed L2 services	Functional description	Justification
	Providing a full set of configuration data, including technical and operational information, that allows the applications to adapt their behaviour to the different airspaces and/or technical environments. This information is normally defined offline in ATM applications through the Adaptation-specific tools and deployed as files. This information is loaded at instantiation and maintained static during runtime. • Semi-dynamic data Configuration data that can be dynamically modified at runtime. At startup, it is initially based on the information provided by Adaptation data, but the owner of the corresponding semi-dynamic data will offer interfaces to allow the modification of the data at runtime that will be then consumed and used by other application components.	

Table 20 - Operational Supervision

D.14 CNS infrastructure and basic services

Agreed L2 services	Functional description	Justification
Software deployment platform	Source: Service Delivery Model Task Force A software deployment platform is an environment designed to support the deployment, operation, and management of applications. Depending on its scope and infrastructure, it can be used for on-premises deployment or in cloud-based services like PaaS (Platform as a Service) or SaaS (Software as a Service). Key Characteristics of a Deployment Platform 1. Infrastructure Agnostic – It should support deployment across	The Task Force opines that the L1 Business service "CNS infrastructure and basic services " should be renamed "CNS and IT infrastructure" for the sake of clarity and consistency.

Agreed L2 services	Functional description	Justification
	multiple environments, including on-premises data centres, private clouds, and public cloud services. 2. Automation & Orchestration – Features like CI/CD pipelines, Infrastructure as Code (IaC), and container orchestration (e.g., Kubernetes) help streamline deployments. 3. Security & Compliance – Includes access control, data protection, and compliance monitoring (e.g., ISO 27001, NIS2). 4. Scalability & Resilience – Ensures applications can scale as needed and maintain high availability. 5. Monitoring & Logging – Provides observability, logs, and performance monitoring for troubleshooting and optimisation. Deployment Models On-Premises – Software is installed and managed on an organisation's infrastructure (e.g., bare metal, VMs, private cloud). PaaS (Platform as a Service) – The platform provides runtime environments, databases, and middleware, while users manage applications (e.g., OpenShift, Azure App Services). SaaS (Software as a Service) – Applications are fully managed and delivered as a service to end users (e.g., Microsoft 365, Salesforce).	

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Agreed L2 services	Functional description	Justification
Network Services	Source: Service Delivery Model Task Force Network services are essential components that ensure secure, reliable, and efficient communication between applications and infrastructure within a deployment platform, whether on-premises, PaaS, or SaaS. These services facilitate connectivity, security, and performance optimisation. Tailoring Network Services for Deployment Models require robust firewalls, VLANs, and high-availability networking, service discovery, API gateways, inter-service communication, DDoS protection, and secure access	The Task Force opines that the L1 Business service "CNS infrastructure and basic services " should be renamed "CNS and IT infrastructure" for the sake of clarity and consistency.

Table 21 - CNS infrastructure and basic services

D.15 Network services

Agreed L2 services	Functional description	Justification
Network services	Source: Service Delivery Model Task Force Network services are essential components that ensure secure, reliable, and efficient communication between applications and infrastructure within a deployment platform, whether on-premises, PaaS, or SaaS. These services facilitate connectivity, security, and performance optimization.	

Agreed L2 services	Functional description	Justification
	Tailoring Network Services for Deployment Models require robust firewalls, VLANs, and high-availability networking, service discovery, API gateways, inter-service communication, DDoS protection, and secure access	

D.16 Simulation, training & analysis services

Agreed L2 services	Functional description	Justification
<< No services identified that would require a standard and/or AMC>>	Source: Service Delivery Model Task Force - Simulation and Training: ATM Simulation and Training service support test and training exercises for ATC controllers and operators by using simulated traffic scenarios that are able to emulate the external interfaces to the ATS facility. This service provides the following functionalities: o Air Traffic Generator: generates all aircraft movements based on predefined flight plans and changes resulting from pseudo-pilot control inputs. This function handles the simulated external input/output, generating all sensor data, air-ground data link messages, flight plan messages, coordination messages, flow control messages, meteorological and aeronautical information messages, and simulated time control to the replica of the operational system	Sim environment for real-time simulation, training, and analytics. Air Traffic Generator (ATG): Generates realistic aircraft movements based on predefined flight plans. Supports pseudo-pilot control inputs for dynamic interaction. Generates sensor data, data link messages, meteorological & aeronautical information. Implements event-driven simulation with time synchronisation. Pseudo-Pilot Position : Simulated tactical control of aircraft responding to ATCO commands. Acts as airborne agents for air-ground data link communications. Supports coordination with adjacent ATS centres. Session Manager Position: Assigns workstations & roles for training. Manages training session

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Agreed L2 services	Functional description	Justification
	o Pseudo-Pilot position: provides the tactical control of aircraft in response to controller commands. It also acts in the airborne role for air-ground data link applications, and as controllers at adjacent ATS centres for coordination o Session Manager Position: provides workstation assignment, selection of prepared exercises, control and modification of each training exercise and overall control for the whole training session o Exercise Preparation Position: design and produce the simulation exercises used during training sessions - Replay o Video and Audio recording and replay service, i.e. “At-The-Glass” recording o Data replay, i.e. reinjection of recorded data to determine the state of any service at any point in time (e.g. incident investigation, errors/bugs analysis, etc.) In a microservices architecture, this may be based on the “event-sourcing” pattern o User interfaces local data recording and replay to determine the state of an individual instance of a user interface at any point in time (e.g. incident investigation). This may be passive or interactive, allowing the user some level of interaction while executing the replay	execution, pause, restart, or modification. Exercise Preparation Position: Enables custom scenario design for ATC exercises. Supports real-time modification of exercises. Replay & Record Services : Video & Audio Recording ("At-The-Glass") Captures screen interactions, voice commands, and user actions. Supports synchronised playback for debriefing & training improvement. Data Replay ("Event-Sourcing"): Event-sourcing pattern replays recorded flight & ATCO actions. Allows incident investigation & bug analysis. Supports state reconstruction at any point in time. Interactive User Replay: Enables replay with active user input to simulate "What-If" scenarios.

Agreed L2 services	Functional description	Justification
	- Legal recording service - ATM Business Intelligence and Business Analytics tools - Logging and Events Management (SIEM) tools	

Table 22 - Simulation, training & analysis services

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D.17 Meteorology

Agreed L2 services	Functional description	Justification
Weather Data Mgmt & Dist (incl. SUPPM, SFD)	Source: SUPPFM and SUPPFD from SESAR ARCHITECTURE. The main functions performed by the Weather Data Mgmt & Dist function are: - Reception and processing of meteorological information from external sources. - Support for actions taken by operators at workstations. - Information distribution to involved systems and positions. The Weather Data Mgmt & Dist includes the functionality of SupportFunctionsManagement (SUPPFM), that provides the operations to manually set the online environmental data QNH, wind speed and direction and temperature for a weather reporting station. The Weather Data Mgmt & Dist also includes the functionality of SupportFunctionsDistribution (SUPPFD), that distributes weather radar data to subscribers. The weather radar information can include: - Mono-radar derived weather information - Composite weather reports - Online environmental data: QNH, wind speed and direction and temperature for a weather reporting station. The Weather Data Mgnt & Dist service also includes meteorology forecasts.	These two services could be split, subject to CBA: - Mono-radar derived weather information - Composite weather reports
AIREP (Air Report)	Source: ICAO annex 3 definition Air-report: A report from the aircraft in flight prepared in conformity with requirements for position, and operational and/or meteorological reporting.	Note this is provided by an ANSP, hence different from the consumption of data.

Table 23 - Meteorology

D.18 Aeronautical information management (AIM)

Agreed L2 services	Functional description	Justification
Static and Dynamic data management	Source: Service Delivery Model Task Force Set of tools and applications allows to manage aeronautical information: - AIM data management, ensuring via databases and tools integrity and consistency of aeronautical information. - Workflow management to enforce ADQ policies - AIP publication management allows to manage the documentation - Charting management allowing to create and manage cartography based on static data	
NOTAM	Source: Service Delivery Model Task Force Provides the capability to manage NOTAM and Digital NOTAM and to distribute them.	
Briefing	Source: Service Delivery Model Task Force Provide the capability to generate tailored PIB according to a flight plan, using AIM data.	
Flight plan filing	Source: Service Delivery Model Task Force Provide the capability to create, validate and submit flight plans	

Table 24 - Aeronautical information management (AIM)

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Appendix E Pace layering of level 2 services

The following colour code is adopted:

- Service with highest innovation opportunities: yellow colour,
- Service with higher innovation opportunities: orange colour,
- Service with low innovation opportunities: blue colour.

L1 business service	L2 service	Outcome of ATM MP WG3 July 2024	Outcome of TF SDM (based on ATM MP SDO)
Human–machine interface (HMI)	Air situation display	Higher	12
	ATM MP: Alerts	Higher	6
	ATM MP: Dialogue	Higher	4
	EATMA: Controller HMI management ER/APP	Higher	4
	Technical Supervision Position HMI	Low	4
Flight data/trajectory management	Flight data management	Higher	6
	Flight data exchange	Low	5
	Correlation	Low	1
	SSR Code Management	Low	0
Sequencing	AMAN	Higher	5
	DMAN	Higher	2
Separation management	Tactical controller tools	Higher	4
	Conflict detection	Low	4
	Conflict resolution and assistance	Highest	4
	'What if–what else' probing	Low	4
	Monitoring Aids (MONA)	Low	3
	ATM MP: Merging and spacing	Low	0
Local air traffic flow and capacity management (ATFCM)	Local demand and capacity balancing (DCB)	Highest	6
	Complexity management	Highest	4
Safety nets	Short-term conflict alerts (STCA)	Low	2
	Minimum safe altitude warnings (MSAW)	Low	0
	Area proximity warnings (APW)	Low	2
	Approach path monitoring (APM)	Low	0
	Non Transgression Zone (NTZ)	Low	
	Ground safety nets MSAW, APW, APM	Low	0

Navigation	Navigation signals	Low	2
	Performance monitoring (navigation)	Low	3
Communication	Automatic Speech Recognition	Highest	1
	Voice control distribution	Low	3
	Voice control management	Low	3
Surveillance	Surveillance data fusion	Low	2
	Tracking	Low	0
Datalink	Controller pilot data link communications (CPDLC)	Low	5
	Automatic dependent surveillance – contract (ADS-C), including extended projected profiles (EPP);	Low	4
	Context management (datalink)	Low	3
Environment (CO2/non-CO2)	CO2 emissions	Higher	2
	Non-CO2 emissions, including contrail management	Higher	2
	Noise	Low	2
Civil/military airspace management	Airspace reservation management (ARES)	Highest	4
	Booking management (Civ/Mil ASM)	Highest	4
	Airspace configuration and distribution	Highest	4
	Airspace status distribution	Highest	4
Operational supervision	Sector configuration	Low	4
	Configuration of parameters	Low	4
	Operational supervision distribution	Low	4
CNS infrastructure and basic services	Deployment (CNS and basic services)	Low	2
	Recording (CNS and basic services)	Low	3
Network services (now included in CNS infrastructure and basic services)	Pan-European network service (PENS)	Low	1
	ATS common data link services (ACDLS)	Low	3
	Future communications infrastructure (FCI)	Low	3
	System-wide information management (SWIM) yellow profile.	Low	4
Simulation, training and analysis services	Traffic generator	Higher	2
	Preparation and execution	Higher	2
	Pseudo-pilots	Higher	2
	Replay function	Higher	2
Meteorology	ATM MP: Winds, convection, Clear air turbulence, Icing	Low	1
	Operational meteorological information (OPMET)	Low	3
	ATM MP: Local weather	Low	2
Aeronautical information management	Notice to airmen (NOTAM)	Low	0
	Digital notice to airmen (D-NOTAM)	Low	4
	Aeronautical information management (AIM) on request	Low	0
	Briefing	Low	3

Table 25 Pace layering of Level 2 services by expert judgment and by ATM MP SDO impact

Note: when the two steps of the pace layering exercise were conducted, the L2 breakdown was not totally stabilised.

The Table 25 features only the intersection with the final L2 service breakdown.

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