WORKING PAPER

ASSEMBLY — 42ND SESSION

TECHNICAL COMMISSION

Agenda Item 24:   Aviation Safety and Air Navigation Priority Initiatives

ACCELERATING INNOVATION IN ATM SERVICE PROVISION

(Presented by Denmark on behalf of the European Union and its Member States[1], the other Member States[2] of the European Civil Aviation Conference, and by EUROCONTROL)

EXECUTIVE SUMMARY

Air traffic management (ATM) systems have traditionally relied on monolithic architectures that are inflexible, costly, and slow to adapt to fluctuating demand. As air traffic evolves and operational complexities increase, these legacy systems struggle to scale efficiently, hindering innovation and interoperability.

There is a clear need for a more dynamic, cost-effective, and adaptable approach to ATM service provision. Recent technological advancements provide an opportunity to modernize through a new service delivery model. Several States in the European (EUR) Region have already begun this transition by adopting a collaborative, multi-supplier approach. This will accelerate innovation including seamless new operational improvements, enhance scalability and cost effectiveness, and improve interoperability. This transition is seen as foundational to ensuring that future ATM systems are agile, resilient, and capable of meeting evolving operational needs.

Assembly Resolution A40-27: Innovation in aviation acknowledges the need to establish an inclusive dialogue at a strategic level that will encourage further collaboration and sharing of experience in relation to innovation. The purpose of this paper is to bring the opportunities presented by this new service delivery model to the attention of ICAO, Member States and industry, and to support the harmonized modernization of ATM worldwide.

Action: The Assembly is invited to:
a)   recognize that a modern, data-driven, service-oriented architecture holds the prospect of accelerating innovation in air traffic management (ATM) service provision;
b)   emphasize that a performance-based regulatory framework can foster innovation in ATM service provision;
c)   acknowledge the need for this new service delivery model for ATM to safeguard State sovereignty, and to ensure safety and security of ATM services;
d)   call for ICAO to use the existing framework on innovation to ensure the timely development of policies that support the new service delivery model for ATM; and
e)   request ICAO to consider integrating the new service delivery model for ATM in the next edition of the Global Air Navigation Plan (GANP, Doc 9750).

Strategic Goals:	This working paper relates to Strategic Goals *Every Flight is Safe and Secure; and Aviation Delivers Seamless, Accessible and Reliable Mobility for all.*

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[1] Austria, Belgium, Bulgaria, Croatia, Cyprus, Czechia, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden

[2] Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Georgia, Iceland, Republic of Moldova, Monaco, Montenegro, North Macedonia, Norway, San Marino, Serbia, Switzerland, Türkiye, Ukraine and the United Kingdom

Financial implications:	The activities referred to in this paper are expected to be undertaken within the resources available in the Regular Budget. The overall cost benefit to States and industry should be positive as resources would be used more effectively and efficiently.
References:	A40-27: Innovation in aviation Doc 9854, *Global Air Traffic Management Operational Concept* (GATMOC) Doc 10199, *Procedures for Air Navigation Services — Information Management (PANS-IM)* Draft International Aviation Trust Framework (IATF)

1. INTRODUCTION

1.1 The rapid growth in computing power and reliable telecommunication networks have accelerated innovation in society. Modern information technology (IT) holds the prospect of significantly improving the provision of air navigation services but also poses new challenges such as protection against ever-evolving security threats. The fundamental aviation principles of State sovereignty, safety, security as well as environmental and economic sustainability must be satisfied.

1.2 Historically, air traffic service (ATS) systems have been architected as monolithic structures relying on physical hardware in colocation facilities using legacy information technologies. They include everything from the basic platform infrastructure to the air traffic controller (ATCO) working position but their use is limited to individual Air Traffic Services units (ATSU). This resulted in systems which typically evolved every 10 to 20 years. Response to fluctuating demand is slow and expensive.

1.3 Recent technological advancements are driving innovation through a more efficient and flexible air traffic management (ATM) service delivery model. This approach enhances ATM data processing, presentation, and updates using structured methods, advanced technology, and streamlined operations. A modern cloud-based service-oriented architecture (SOA) accelerates innovation by enabling reusable, interoperable functionalities accessible remotely. Supplier-neutral and standardized interfaces ensure seamless integration across systems. Efforts are underway to adopt dedicated aeronautical cloud infrastructures and distributed data centres for improved scalability, resilience, and efficiency in ATM. Specific focus is put on security-by-design considerations to prioritize, inter alia, cybersecurity and infrastructure vulnerabilities as a core requirement.

2. DISCUSSION

2.1 The need to accommodate traffic growth and changing traffic patterns, including the integration of new entrants, demands an acceleration in innovation and in the deployment of operational improvements. Many States and regions are already investing in trajectory based operation (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.

2.2 In the European Union, within the framework of the Single European Sky (SES), the newly adopted European ATM Master Plan 2025 has established a number of strategic deployment objectives striving for greater efficiency, sustainability, resilience, safety and security of future ATM systems. They cover functionalities that need to be rolled out between 2025 and 2035. Foundational is the transition to a new service delivery model for ATM. This approach takes advantage of guiding principles in other safety and security domains. Legacy monolithic systems will be replaced by a modern cloud-based SOA. Built on standardized architectures and open interfaces, this model promotes innovation and interoperability, allowing seamless collaboration among stakeholders. Key advantages are:

    a) interoperability across system providers through open platforms and interfaces, enabling multi-supplier solutions;

b) decoupling of service and infrastructure layers for greater flexibility in designing and deploying operational functionalities; and

c) a cloud native architecture of services with standardized, open interfaces that operate on commodity cloud technologies.

2.3   While no industry standard defines the exact composition of a service-oriented architecture, various stakeholders have developed guiding principles. A successful implementation of such a delivery model requires a common service breakdown, driven by harmonized information management principles, models and open standards (e.g. SWIM, AIXM, FIXM, AMQP) to:

a) seamlessly integrate new or updated functionalities without overhauling entire systems;

b) ensure efficient data sharing and communication across aviation stakeholders (airlines, airports, air navigation service providers (ANSPs), manufacturers, regulators), via application programming interfaces;

c) unlock data and enable faster feature deployment without disrupting operations;

d) leverage real-time data processing for improved air traffic predictions and -decision making;

e) enhance scalability to optimise cost and service-efficiency;

f) improve resilience with location-independent, redundant ATM data service; and

g) reduce time to operations through modular functionalities and standardized interfaces.

2.4   It is vital that international civil aviation takes timely action to monitor and evaluate these developments in innovation for them to deliver on their potential benefits, in a manner that leaves no country behind. There is a need to establish an inclusive dialogue at strategic level that will encourage further collaboration and sharing of experience in relation to innovation. This should help minimize different approaches of States, operational stakeholders and industry. Assembly Resolution A40-27: Innovation in aviation recognizes that the nature and pace of innovations require regulators to avail themselves of new methodologies that facilitate the timely evaluation and assessment of technological developments.

2.5   It is recognized that a performance-based regulation, that focuses on desired, measurable outcomes, rather than prescriptive processes, techniques, or procedures, has the potential to foster innovation, while ensuring safety and effectiveness. It should be noted, however, that such a regulatory concept is not always sufficient, in particular when interoperability needs to be ensured.

3.   **AREAS FOR CONSIDERATION**

3.1   Given the above, ICAO should consider supporting the development of the new service delivery model for ATM by facilitating work in the following areas:

a) requirements needed to safeguard State sovereignty;

b) compatibility with SOA and cloud computing, and the acceleration of innovation and deployment;

c) required performance and related safety-assurance for the different layers (separating services, infrastructure and network) in a performance-based approach;

d)   security-by-design considerations to prioritize, inter alia, cybersecurity and infrastructure vulnerabilities as a core requirement;

e)   appropriate levels of regulatory flexibility and standardisation granularity to allow for innovation while ensuring safety, interoperability and enabling a multi-supplier environment;

f)   roles and responsibilities of the services integrator and of specialized ATM data service providers; and

g)   a roadmap for implementing such transformation.

4.   **CONCLUSION**

4.1   The transition to a modern, data-driven, and cloud-based service-oriented architecture holds the prospect of significantly improving air traffic management by making systems more scalable, cost-efficient, resilient, fit-for-purpose, and future-ready. It is expected to also enable better data-driven decision-making, enhance security, and allow for potentially safer and more efficient airspace operations. Global efforts to support this transition should primarily focus on the need for more flexibility in the development and delivery of future ATM systems and services, on assisting States in understanding how to develop regulatory frameworks which make the best use of emerging technologies while providing for a harmonized approach for aviation regulators and industry.

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