



WORKING PAPER

TWELFTH AIR NAVIGATION CONFERENCE

Montréal, 19 to 30 November 2012

Agenda Item 4: Optimum capacity and efficiency – through global collaborative ATM

4.1: Efficient management of airspace and improved flow performance through collaborative decision-making (CDM)

**AVIATION SYSTEM BLOCK UPGRADE MODULES RELATING
TO NETWORK OPERATIONS**

(Presented by the Secretariat)

EXECUTIVE SUMMARY

The 37th Session of the ICAO Assembly directed ICAO to increase its efforts to meet global needs for airspace interoperability while maintaining its focus on safety. To this end, a planning framework for global harmonization and interoperability named the aviation system block upgrades (ASBU) is proposed to the Conference for incorporation into the Fourth Edition of the *Global Air Navigation Plan*.

The ASBU framework includes modules over a series of blocks, supported by technology roadmaps, which serve to progressively enhance many aspects of civil aviation operations. This paper presents the modules relating to Network Operations, which comprise:

- a) B0-10, B1-10 and B3-10 – Enhanced en-route trajectories; and
- b) B0-35, B1-35 and B2-35 – Improved flow performance through network wide planning.

Action: The Conference is invited to agree to the recommendation in paragraph 3.

<i>Strategic Objectives:</i>	This working paper relates to the Safety Strategic Objective.
<i>Financial implications:</i>	Air navigation service providers (ANSPs) may need to undertake considerable evolution and are expected to incur moderate costs. However, based on preliminary indications, the benefits of implementing these modules could be substantial for individual ANSPs as well as global system performance and, when implemented, the benefits are expected to far outweigh the costs.
<i>References:</i>	Doc 9958, <i>Assembly Resolutions in Force (as of 8 October 2010)</i> Doc 9854, <i>Global Air Traffic Management Operational Concept</i> Doc 9750, <i>Global Air Navigation Plan</i> AN-Conf/12-WP/3 AN-Conf/12-IP/10

1. INTRODUCTION

1.1 The next edition of the *Global Air Navigation Plan* (Doc 9750, GANP), will be presented to the ICAO Assembly in 2013 for approval. The draft GANP, and the aviation system block upgrade (ASBU) strategy it establishes proposes that future air navigation technology and procedure improvements are organized and based on a consultative strategic approach that coordinates specific global performance capabilities and the flexible upgrade timelines associated with each.

1.2 The ASBU modules are organized into flexible and scalable building blocks that can be implemented depending on the operational need, while recognizing that implementation of a particular module is not mandatory in all areas or circumstances. The approach adopted is not limiting and recognizes that deployment in addition to the material described in the ASBUs may also take place or be necessary. The broad timescales associated with the ASBU framework (Block 0 = 2013, Block 1 = 2018, Block 2 = 2023, Block 3 = 2028) are intended only to depict the initial readiness of all components, including ICAO Standards and Recommended Practices (SARPs), needed for deployment and do not imply a mandated State or regional implementation timeframe. The ASBU framework with supporting technology roadmaps ensures that State and regional implementation planning and deployment activities can be undertaken with the confidence that all components necessary for a particular deployment will be available within the ASBU dates mentioned.

1.3 Network operations may be best described as a series of processes to manage flows or groups of flights to improve overall traffic fluidity in large or complex airspace containing multiple airports and perhaps multiple flight information regions (FIRs) (hence covering a regional or subregional area) in order to better manage the capacity available. Network operations are also considered to include capacity management and planning, as well as airspace design and management. The network manager function adopted by EUROCONTROL is an example. Network operations may also enhance collaborative decision-making (CDM) amongst stakeholders in real-time to take advantage of system capabilities and adopt user preferences to assist air traffic flow management (ATFM) in making the most efficient use of airspace resources on an equitable basis. To support the network operation and management activities, the following two planning threads, as described in the appendices to this paper and illustrated in the attached Figure 1, are proposed for inclusion in the ASBU framework:

- a) enhanced en-route trajectories; and
- b) improved flow performance through network wide planning.

2. NETWORK OPERATIONS

Overall strategy

2.1 In a network operations environment, management tools are introduced to provide a wider and/or earlier perspective on actual and anticipated traffic disposition such that events and phenomena (e.g. physical limitations and economic reasons) that affect traffic flows can be addressed. An accurate and rich information environment proffered by a system-wide information management (SWIM)-based air traffic management (ATM) system that supports CDM applications could permit users to manage competing demands and enable prioritization of complex ATFM solutions when the network or its nodes (airports, sector) are so congested that they no longer provide sufficient capacity to meet demands.

2.2 Key elements of the global strategy to manage existing and forecasted increases in air traffic include efficient and effective design and management of airspace combined with advanced ATFM and capacity management processes that capitalize on aircraft and ground system capability in full. However, airspace congestion and flight delays will always potentially exist. The dynamic use of airspace may help to reduce congestion on trunk routes and busy crossing points, and adapting the actual flight trajectory to the user-preferred profile should result in reduced fuel burn and emissions.

Incremental development

2.3 The ASBU concept facilitates the step by step deployment of operational improvements within the boundaries of an overall planning framework. At the last of the current planning stages (Block 3), 4D trajectory capabilities allow routine optimization of individual trajectories, general traffic flows and scarce resources such as runways and airspace. At this stage, the management of constraints in high traffic densities and/or complex environments may result in the need to work much closer to system limits, while maintaining safety. Network operations tools and procedures are intended to manage closely interacting systems and processes to maximize overall system performance.

2.4 In the first stage (Block 0), a combination of strategic and tactical air traffic flow management and CDM should be able to deliver accurate and efficient decision making in an environment of stretched resources. Carefully considered airspace planning and design, based on practices such as flexible routing and flexible use of airspace (FUA), could result in significant improvements in operations and overall management of airspace congestion without large investments in technology.

2.5 With Block 1 deployment, user preferred routing, reduced route spacing and dynamic sectorization should benefit from improved aircraft navigation performance, enhanced surveillance and real-time information on traffic disposition. Concurrently, the development of new ATFM algorithms and techniques such as prioritization processes and further development of CDM could reduce airspace constraints.

2.6 In Block 2, advanced ATFM, capacity management and CDM processes should fully benefit from the accurate and rich information environment provided by SWIM. It is also anticipated that some CDM applications will allow ATM to offer, or delegate to, airspace users the optimization of solutions to flow problems.

2.7 Further development and implementation of FUA principles are needed worldwide. FUA principles will need to be taken into account in respect of the ASBU modules and technological roadmaps and should include standardization of airspace design processes as well as application of other concepts based on CDM. A comprehensive revision of existing ICAO provisions on FUA and associated principles should be developed, including the development of supporting material on:

- a) details of procedures and requirements for the global implementation and application of the flexible use of airspace concept;
- b) the concept for the application of an airspace management (ASM) support tool with associated functional system specifications meant to enable and/or enhance a more efficient CDM process in airspace management;
- c) standardization of the airspace design process(es) based on common principles ensuring the alignment with the FUA concept; and

- d) a 4D trajectory-based airspace environment thus moving from airspace to trajectory focus in the 4th dimension based on CDM by all users.

2.8 Harmonization of arrangements and enhanced interoperability between civil and military ATM systems is essential to facilitate operations conducted in a mixed civil/military environment, by developing a civil/military CNS/ATM interoperability roadmap which describes essential requirements.

Technology requirements

2.9 Network operations need a performance-based navigation (PBN) compatible operational environment. As such, PBN technology requirements will also serve the network operations environment. ATFM and CDM technology enhancements, particularly those based on enhanced flight plan related information such as FF-ICE and SWIM, will also serve to improve network operations. However, the capacity to develop advanced ATFM, capacity management and CDM capabilities is directly dependent on FF-ICE and SWIM development. Technology requirements and the linkages between the various Blocks and modules of the ASBU framework are detailed in the technology roadmaps that constitute part of the draft Fourth Edition of the *Global Air Navigation Plan (GANP)* (AN-Conf/12-WP/3 refers).

Deployment considerations

2.10 The implementation of effective and efficient network operations depends upon several key elements involving real-time coordination between airspace users and ground based stakeholders, including the military. Progressive deployment of FF-ICE should benefit advanced ATFM, capacity management and CDM applications. Development of ICAO provisions on ATFM, capacity management and CDM and for the exchange of trajectory information will be necessary. Based on the need to standardize system messages and interface controls, full implementation of AIDC between automated ATS ground systems on a global scale should be urgently pursued. Similarly, to enhance airspace management widespread implementation of flexible use of airspace provisions and non-traditional route structures and systems should be pursued. Increase activity in sharing experience in airspace capacity and complexity assessment methodologies would be beneficial.

2.11 Network operations can be deployed on a national scale, at least for CDM, FUA, ATFM and capacity management purposes. However, greater benefits would result from the management of interacting traffic flows in the more complex or widespread situations characteristic of a sub-regional or regional scale. Depending on the circumstances, the capacity to organize and gain benefits from network operations requires robust arrangements between stakeholders, which could include a number of participating States agreeing to one of their number acting on behalf of the rest to provide services. A subregional or regional ATFM centre is an example of a component of network operations.

2.12 States and users are urged to give due consideration to the potential added benefits which could result from the integration of a number of modules across a number of threads. Aspects of the integration of several supporting systems at an early stage may generate additional benefits downstream (i.e. Blocks 2 and/or 3). Benefits from an integrated implementation of all modules are expected to be greater than the sum of all benefits attributable to individual modules.

2.13 Detailed information on the components ATFM and CDM of network operations is given in AN-Conf/12-IP/10. Guidance material on the two components will be included in Doc 9971 and will be posted on the AN-Conf/12 website prior to the Conference.

3. CONCLUSION

3.1 The ASBUs describe ways to apply the concepts defined in the *Global Air Traffic Management Operational Concept* (Doc 9854) to achieve local and regional performance improvements. The ultimate goal is global interoperability. Safety and efficiency demands this level of interoperability and harmonization which must be achieved at a reasonable cost with commensurate benefits. The Conference is invited to agree to the following recommendation:

Recommendation 4/x - ICAO aviation system block upgrades (ASBUs) relating to network operations

That the Conference:

- a) urge States to implement collaborative decision-making processes in the provision of services;
- b) urge States, according to their operational needs, to implement the aviation system block upgrade modules relating to network operations included in Block 0, as presented in Appendices A and B;
- c) endorse the aviation system block upgrade modules relating to network operations included in Block 1, as presented in Appendices C and D, and recommend that ICAO use them as the basis of its work programme on the subject;
- d) endorse the aviation system block upgrade modules relating to network operations included in Blocks 2 and 3, as presented in Appendices E and F, as the strategic direction for this subject;
- e) request ICAO to include, following further development and editorial review, the aviation system block upgrade modules relating to network operations in the draft Fourth Edition of the *Global Air Navigation Plan*; and
- f) request ICAO to develop further provisions and guidance on flexible use of airspace principles for future use and in preparation for future 4D trajectory-based airspace management.

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Figure 1. Block upgrade modules covered in this working paper

