International Civil Aviation Organization

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WORKING PAPER

TWELFTH AIR NAVIGATION CONFERENCE

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Agenda Item 5: Efficient flight paths – through trajectory-based operations
5.3: Increased flexibility and efficiency in descent and departure profiles

AVIATION SYSTEM BLOCK UPGRADE MODULES RELATING TO CONTINUOUS CLIMB OPERATIONS AND CONTINUOUS DESCENT 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 continuous climb operations (CCO) and continuous descent operations (CDO), which comprise:

a) B0-05, B1-05 & B2-05 – Improved flexibility and efficiency in descent profiles; and
b) B0-20 – Improved flexibility and efficiency in climb profiles.

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

Strategic Objectives:	This working paper relates to the Safety Strategic Objective.
Financial implications:	The cost impact for these modules is expected to be minimal and are anticipated to be borne predominantly by the air navigation service providers (ANSPs) on the basis that facilitating operator capabilities, such as performance-based navigation (PBN) and controller-pilot data link communications (CPDLC), are attributable to those programmes rather than to CCO and CDO. Based on preliminary indications, the benefits of implementing these modules could be substantial for overall global system performance and, when implemented, the benefits are expected to far outweigh the costs.
References:	Doc 9958, *Assembly Resolutions in Force (as of 8 October 2010)* Doc 9854, *Global Air Traffic Management Operational Concept* Doc 9750, *Global Air Navigation Plan* AN-Conf/12-WP/3

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 component.

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 Continuous descent operations (CDO) combine airspace and procedure design with air traffic control (ATC) procedures that permit flights to descend continuously from top of descent (TOD) to the vicinity of the airport, without segments of level flight, in a low drag configuration and using minimum thrust. continuous climb operations (CCO) follow the same objectives for the climb phase after departure. Two planning threads, one each for CCO and CDO as described in the appendices to this paper and illustrated in the attached Figure 1, are proposed for inclusion in the ASBU framework

2. ASBU MODULES – CONTINUOUS CLIMB AND DESCENT OPERATIONS

Overall strategy

2.1 Deployment of CCO and CDO procedures is expected to optimize traffic throughput using fuel and noise efficient climb and descent profiles. Consequent flexibility in airspace design should realize further reductions in emissions and aircraft noise impacts and facilitate reduced separation and flow management to increase overall capacity in terminal areas. The stability and predictability of flight paths assist pilot and air traffic controllers decision-making.

Incremental development

2.2 From Block 0, the structured optimization of CCO and CDO flight profiles will be facilitated by using PBN capabilities and arrival/departure procedures design to allow aircraft to fly their preferred profile for a particular airspace. In the next phase (Block 1), improved vertical navigation capabilities contribute to terminal airspace design by requiring aircraft to maintain an accurate vertical path, allowing construction of vertically bounded corridors in order to organize traffic flows. Aircraft are able to fly approach procedures that do not rely on ground based equipment for vertical navigation.

2.3 With Block 2, arrival procedures are further enhanced to include CDO’s using vertical navigation (VNAV), required speed and time of arrival. In busy airspace, these enhancements will incorporate airspace complexity, air traffic workload and procedure design elements. The aircraft’s ability to accurately fly an optimized arrival, coupled with the state and intent information sent from the aircraft

to ATC automation, will increase accuracy of trajectory modelling and problem prediction. The consistent 3D trajectory information available will inform air traffic management (ATM) decision-making based on automated decision support capabilities.

Technology requirements

2.4 PBN technology requirements will also serve the CCO and CDO environment. In the later stages, increasing reliance is placed on data link communications for the exchange of trajectory data. The development of standards and coordinated implementation of a Common Time Reference for all systems, in the air and on the ground, would provide a basis for the synchronisation of all operational information.

2.5 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

2.6 CDO and CCO comprise of functional enhancements that are able to be deployed in basic iterations at minimal cost today, using available guidance material such as the ICAO *Continuous Descent Operations (CDO) Manual* (Doc 9931). As the procedures are generally airport specific, deployment can be authorized on the basis of local decisions and immediate benefits will accrue at individual airports. However, in cases where interdependencies in terms of traffic flows and airspace management strategies exist between airport pairs, the full benefits of CCO and CDO may only be achieved through coordinated implementation.

2.7 Aircraft equipage is a significant contributor and the reliance on area navigation (RNAV) and required navigation performance (RNP) capabilities requires the continued development of PBN provisions as well as increased PBN implementation worldwide. ICAO provisions and guidance material are also necessary to support trajectory modelling and trajectory information exchange, and enhanced provisions for data link applications and messages will support exchange of trajectory data.

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 demand 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 5/x – ICAO aviation system block upgrades (ASBUs) relating to continuous climb operations and continuous descent operations (CCO and CDO)

That the Conference:

a) urge States, according to their operational needs, to implement as a matter of urgency the aviation system block upgrade modules relating to continuous climb operations and continuous descent operations included in Block 0, as presented in Appendices A and B;

b) endorse the aviation system block upgrade module relating to continuous descent operations included in Block 1, as presented in Appendix C, and recommend that ICAO use it as the basis of its work programme on the subject;

c) endorse the aviation system block upgrade module relating to continuous descent operations included in Block 2, as presented in Appendix D, as the strategic direction for this subject; and

d) request ICAO to include, following further development and editorial review, the aviation system block upgrade modules relating to continuous climb operations and continuous descent operations in the draft Fourth Edition of the *Global Air Navigation Plan.*

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Figure 1 – Block Upgrade Modules Covered in this Working Paper