



WORKING PAPER

THIRTEENTH AIR NAVIGATION CONFERENCE

Montréal, Canada, 9 to 19 October 2018

COMMITTEE A

Agenda Item 3: Enhancing the global air navigation system

3.2: Flight and flow — information for a collaborative environment (FF-ICE) and trajectory-based operations (TBO)

GLOBAL TRAJECTORY-BASED OPERATIONS (TBO) CONCEPT AND ICAO PROVISIONS FOR FLIGHT AND FLOW — INFORMATION FOR A COLLABORATIVE ENVIRONMENT (FF-ICE)

(Presented by the Secretariat)

EXECUTIVE SUMMARY

The *Global Air Traffic Management (ATM) Operational Concept* (Doc 9854) has provided direction to global and regional efforts for the development of the future ATM system. The key conceptual changes envisaged have already come to reality in different parts of the world with varying levels of maturity. Still to be achieved, however, is an evolutionary transformation into a trajectory-based operations (TBO) environment where the current and future positions of aircraft are known to a higher degree of detail and accuracy. This paper presents the current developments with respect to TBO and one of its key enablers, flight and flow-information for a collaborative environment (FF-ICE). The paper also highlights areas where further work is required to support the development and implementation of FF-ICE and TBO.

Action: The Conference is invited to agree to Recommendation 3.2/x —Trajectory-based operations (TBO) and Recommendation 3.2/x — Flight and flow-information for a collaborative environment (FF-ICE) in paragraph 3.

<i>Strategic Objectives:</i>	This working paper relates to the Safety and Air Navigation Capacity and Efficiency Strategic Objectives.
<i>Financial implications:</i>	<p><i>Impact for the aviation community:</i> Considerable opportunities are associated with the implementation of TBO and FF-ICE. The aviation community at large will benefit from the development of a regulatory framework that will support the transition from the current system to a TBO environment (incorporating FF-ICE).</p> <p><i>Impact for ICAO (relative to the current Regular Programme Budget resource levels):</i> The ICAO activities referred to in this working paper will continue over the next triennia and additional resources are required, both financial and human, to support ICAO's efforts in the highly specialized areas associated with TBO and FF-ICE.</p>
<i>References:</i>	<p>AN-Conf/13-WP/4 AN-Conf/13-WP/8 AN-Conf/13-WP/10 Doc 9854, <i>Global Air Traffic Management Operational Concept</i></p>

	<p>Doc 9750, <i>Global Air Navigation Plan</i> Doc 9965, <i>Manual on Flight and Flow — Information for a Collaborative Environment (FF-ICE)</i> Doc 10039, <i>Manual on System-Wide Information Management (SWIM) Concept</i></p>
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1. INTRODUCTION

1.1 The *Global Air Traffic Management (ATM) Operational Concept* (GATMOC¹, Doc 9854), has provided direction to global and regional efforts for development of the future ATM system. The key conceptual changes envisaged in the GATMOC have already come to reality in different parts of the world with varying levels of maturity (e.g. dynamic and flexible airspace management and accommodation of mixed capabilities, etc.).

1.2 Still to be achieved, for further realization of the vision² of the GATMOC, is an evolutionary transformation into a trajectory-based operations (TBO) environment where the current and future positions of aircraft are known to a higher degree of detail and accuracy. To ensure that such a transformation occurs in a consistent, harmonized and integrated manner, the global ATM community needs a common reference and framework that will guide development and implementation of individual, but inter-related capabilities and processes.

2. DISCUSSION

2.1 Global TBO Concept

2.1.1 TBO, often referred to as the “operational realization” of the GATMOC, is the subject of large-scale regional ATM modernization programmes and of cross-industry initiatives on the development and deployment of future technologies. For TBO to deliver its anticipated performance benefits, all capabilities and processes integral to TBO should be developed and deployed in a globally harmonized manner. It is therefore essential that all stakeholders have a common understanding of TBO in its entirety, including required interactions among the supporting capabilities and processes.

2.1.2 To this end, ICAO has been developing a global concept of TBO, with the support of the Air Traffic Management Requirements and Performance Panel (ATMRPP), in an effort to align global developments, interpretations and terminologies concerning TBO. The latest draft of the “Global TBO Concept” and supporting operational scenarios are provided at www.icao.int/airnavigation/tbo³.

2.1.3 The Concept describes an ATM environment where a flown flight path is as close as possible to the user-preferred one by reducing potential conflicts and resolving demand/capacity imbalances early and efficiently. In such an environment, a four-dimensional (4D) flight trajectory collaboratively developed, managed and shared would serve as a common reference for decision-making across all stakeholders.

2.1.4 The Concept will describe: a) the link with the seven ATM operational concept components outlined in the GATMOC; b) required capabilities for airspace users (AUs) and ATM service providers; c) the increasing need for advanced automation and decision support systems; and d) the process for transition that considers mixed mode environment.

¹ The concept was endorsed by the Eleventh Air Navigation Conference (AN-Conf/11, 2003) and recognized by the 35th Session of Assembly (in 2005, Montreal) ((ANConf/11, Recommendation 1/1 and A35-15, Appendix B, Resolving Clause 1 refer).

² “to achieve an interoperable global air traffic system, for all users during all phases of flight, that meets agreed levels of safety, provides for optimum economic operations, is environmentally sustainable and meets national security requirements”

³ This website will be launched prior to the Conference.

2.1.5 The evolution towards the full implementation of TBO is also an integral part of the development and future deployment of the Aviation Systems Block Upgrade (ASBU) Framework of the Global Air Navigation Plan (GANP). Therefore, better linkage between the Global TBO Concept and relevant ASBU elements will be provided in the next edition of the GANP and ASBU framework.

2.1.6 To support such evolution, ICAO still needs to address a number of multi-disciplinary issues, prior to initiating the development of necessary Standards and Recommended Practices (SARPs), procedures and guidance material. These include, but are not limited to the following, some of which were highlighted during the Global Air Navigation Industry Symposium (GANIS) and the Safety and Air Navigation Implementation Symposium (SANIS) (Montréal, 11 to 15 December 2017) :

- a) rules for information sharing (e.g. what information needs to be shared, in what detail and for what purpose) to ensure system optimization and operations stability;
- b) optimum level of automation while keeping the “human in control” for operationally-critical decisions and responses;
- c) minimum deployment scenarios for different operating environments to make TBO cost-beneficial;
- d) mechanisms that balance the efficiency of individual flights with the stability and efficiency of the network as a whole;
- e) required competencies and skills of aviation personnel (air traffic controllers, pilots, and flight operations officers, etc.);
- f) better integration of AUs and aerodrome operators (e.g. flight operations centre and airport operations centre) in collaborative decision-making (CDM) processes;
- g) means and criteria for performance management on automation and decision-making processes; and
- h) the extent of integrating new types of operation (e.g. unmanned aircraft and unmanned aircraft systems traffic management (UTM)).

2.2 Incremental development and implementation of FF-ICE

2.2.1 The concept described in the *Manual on Flight and Flow — Information for a Collaborative Environment (FF-ICE)* (Doc 9965), referred to as “FF-ICE”, is one of the key enablers for TBO as it would deliver necessary capabilities, such as trajectory negotiation between AUs and ATM service providers and dynamic flight and flow information sharing among all concerned stakeholders. FF-ICE also helps to define information needs and supporting processes for flight planning and trajectory and flow management.

2.2.2 For initial implementation of FF-ICE, the aviation community agreed⁴ to develop all necessary tools to address the issues associated with the current flight planning mechanism and establish the basis for transition towards the implementation of full FF-ICE. In this context, ICAO has been developing proposals for amendment to the Annexes, *Procedures for Air Navigation Services (PANS)* and guidance material, with an applicability date of November 2020. Technical and operational validation of these proposals is in progress.

2.2.3 The proposals were developed to enable FF-ICE to be introduced on a voluntary basis, but in a standardized manner. Therefore, the high-level requirements concerning “flight plan” or “flight planning” will continue to be in effect and the proposed amendment are mainly to accommodate the following changes brought by the initial implementation of FF-ICE:

- a) use of global unique flight identification (GUFI);

⁴ The Twelfth Air Navigation Conference (AN-Conf/12, 2012), Recommendation 3/5 – Operational performance through flight and flow- information for a collaborative environment refers.

- b) use of an additional service that would allow pre-departure negotiation and coordination between AUs and ATM service providers;
- c) expanded scope of flight plan information; and
- d) more flexible means of exchanging flight plan information.

2.2.4 FF-ICE, as one of the early adopters for system-wide information management (SWIM), is dependent on the activities described in AN-Conf/13-WP/4. One of the common areas of interest is the development of an efficient and interoperable transition strategy. As such, the development of the proposed amendments concerning initial implementation of FF-ICE should be fully coordinated and synchronized with the development of SWIM.

2.2.5 The next evolution of FF-ICE involves post-departure flight and flow information exchanges and processes supporting airborne trajectory negotiation between AUs and ATM service providers. These exchanges will enable the synchronization of the agreed trajectory across participating AUs and ASPs. In this regard, investigation of required information exchange and supporting processes has already started in close coordination with other relevant programmes, such as air traffic flow management (ATFM) and the global aircraft distress and safety system (GADSS), described respectively in AN-Conf/13-WP/8 and AN-Conf/13-WP/10.

2.2.6 Another important consideration is whether and when to end the mixed mode operation of current flight planning mechanisms and FF-ICE. If appropriate, an eventual sunset date should be determined when sufficient experience with the initial implementation of FF-ICE is gained and all necessary tools for deployment of full FF-ICE are defined, validated and tested. In the meantime, a transition strategy, supported by a positive cost-benefit analysis, will need to be developed to minimize any potential negative impacts.

3. CONCLUSION

3.1 In light of the above, the Conference is invited to agree to the following recommendation:

Recommendation 3.2/x —Trajectory-based operations (TBO)

That the Conference:

- a) request ICAO to finalize the Global Trajectory-based Operations (TBO) Concept in alignment with the next edition of the Global Air Navigation Plan (GANP) and the Aviation Systems Block Upgrade (ASBU) Framework; and
- b) urge States and industry stakeholders to work through ICAO to identify and address potential issues for successful development and implementation of TBO.

Recommendation 3.2/x — Flight and flow-information for a collaborative environment (FF-ICE)

That the Conference:

- a) urge States and industry stakeholders to work through ICAO to mature the proposals for amendment to Annexes, PANS and guidance material in support of the initial implementation of FF-ICE and provide the results of operational and technical validation and cost-benefit analysis;
- b) request ICAO to develop a robust transition strategy to minimize any potential negative impacts during the mixed mode operations of current flight plan mechanisms and FF-ICE; and
- c) request ICAO to continue its work concerning the investigation of necessary information exchange and supporting processes for the next evolution of FF-ICE.