International Civil Aviation Organization

AN-Conf/13-WP/38
31/8/18

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)

TRAJECTORY-BASED OPERATIONS

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

EXECUTIVE SUMMARY

This paper supports the trajectory-based operations (TBO) concept as the transformation of air traffic management (ATM) accommodating the continuous evolution of demand including new entrants and the military. The paper requests for additional focus on the changing role of air traffic flow management (ATFM), the need for automation and consequential change of role of the human, need for expedited development and implementation of key enablers such as system-wide information management (SWIM) and flight and flow information for a collaborative environment (FF-ICE) in a way that takes account of regional ATM developments.

Action: The Conference is invited to agree to the recommendations in paragraph 3.2

1. INTRODUCTION

1.1 For many years, the *Global Air Traffic Management (ATM) Operational Concept* (Doc 9854, GATMOC) has been a stable reference and target for the evolution of ATM, driven by a continuous need to improve performance. The main conceptual paradigm change in the GATMOC is a seamless ATM using management by trajectory based on synchronised collaborative decision-making principles.

1.2 Although evolutionary steps have been made towards the GATMOC, the fundamental change of management by trajectory still has to be developed and implemented. This change will enable

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

[2] Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Georgia, Iceland, Republic of Moldova, Monaco, Montenegro, Norway, San Marino, Serbia, Switzerland, The former Yugoslav Republic of Macedonia, Turkey and Ukraine.

the synchronisation of decision making processes (or in GATMOC terminology, the integration of the concept components). It will be enabled by digitalisation of ATM; automation and information sharing which will be needed to provide the levels of performance to accommodate the increasing demand and to integrate and interface with management systems that manage operations of the new types of airspace users. TBO will also be instrumental for civil-military co-operation[3] and managing operations of new types of airspace users operating above airspace used today for civil aviation.

1.3 To guide the way towards the paradigm change, the ICAO Air Traffic Management Requirements and Performance Panel (ATMRPP) has detailed the principle of management by trajectory into the concept for trajectory-based operations (TBO). The document has been developed through several iterations including peer panel review.

1.4 AN-Conf/13-WP/7 presents the current situation and recommended steps to be taken on TBO and its key enablers. This paper supports and builds on this working paper, and emphasises the importance for TBO and focuses on additional steps to be taken.

2. DISCUSSION

2.1 It is important to recognise the TBO concept as a concept for all operational environments irrespective of traffic density since it will enable increased efficiency including integration of decision making processes into a global collaborative ATM environment. The 2019 edition of the global air navigation plan (GANP) is expected to become the high-level ATM-wide TBO transition plan. In addition, provisions and implementation guidance need to be developed to guide transition and to further specify the relationship/dependencies between decision making processes.

2.2 Synchronisation between and enhancement of decision making processes provides significant opportunities and challenges. The amount and complexity of information and overall of decision making will rapidly increase (e.g. optimizing individual flights balanced against network optimization in an equitable manner) and needs to be supported through appropriate levels of automation. This will also result in a shift of the role of the human. It is therefore necessary that the role of the human is addressed as an integral part of the TBO development. This should be done addressing change management right from the beginning and using a structured approach based on an automation model.

2.3 At the network management level, regional and global interoperability will contribute to significantly improve the consistency and accuracy of the shared trajectory, resulting in a higher performance of ATFM, demand and capacity balancing (DCB), short term ATFM measures and the quality of information shared with airport and airspace users as shown by several large scale cross border demonstrations (e.g. Project NCM: Network Collaborative Management). Network management (planning) functions will also apply in the flight execution phase for the down-stream parts of the trajectory. Moreover, in environments with high fragmentation of air navigation services providers (ANSPs), there will be a need for an “honest broker” to ensure the equitable processing of sometimes complex combinations of incompatible needs. It is therefore necessary to further expand the concept for global collaborative ATFM as integral part of the TBO development.

2.4 In the execution phase, regional and global interoperability of flight data exchanges will improve safety and capacity by ensuring a permanent and consistent view of all flights, even though processed by different flight data processing systems. This will reduce air traffic controller (ATCO) workload thanks to a better anticipation of traffic, more efficient coordination compared with current

[3] Reference to AN-Conf/13-WP/39

inter-center coordination mechanisms (on-line data interchange (OLDI) and ATS interfacility data communications (AIDC)) and more efficient negotiations with upstream and downstream units compared to current voice negotiations. Airspace users will be continuously informed about the flight progress, deviations from the desired trajectory and any constraints (weather, hotspot, etc.), which will allow them to optimize trajectories anytime.

2.5 Implementation of the first phase of FF-ICE, FF-ICE/planning, the modern flight plan format, should be given priority to enable a timely evolution of TBO. The use of system-wide information management (SWIM) information services relying on Flight Information Exchange Model (FIXM) will be key to share a rich flight description between airspace users, computer flight plan software providers (CFSP), Network Manager/ATFM, airports and ANSPs, enabling the development of various applications and increased automation. As a transition step towards FF-ICE, the military have chosen to develop a flight plan format that includes the mission trajectory. This improved flight plan which captures airspace needs can be processed at the network level and shared on a need-to-know basis to facilitate cross border instrument flight rules (IFR) transits including remotely piloted aircraft systems (RPAS).

2.6 In the perspective of the second phase of FF-ICE as a key enabler to seamless ATM, Europe has progressed on defining the Interoperability (IOP)/Flight Object concept for the continuous exchange of flight information between various ANSPs and network operations. This concept is based on a foreseen SWIM technical infrastructure targeted at supporting secured interactions in real-time with a very high availability. The Flight Object data structure is embedding clusters of data in a flexible way and will rely on SWIM and the underlying exchange model FIXM to ensure global information exchange interoperability. In particular, the use of flight scripts enables the sharing of constraints and clearances to build common and accurate views of 4D trajectories. It also offers advanced negotiation capabilities through the ‘What If Flight Object’ to probe trajectory changes across multiple centres. At any given time, the common flight reference dataset is managed by applying data management roles and responsibilities, ensuring updates and publication of flight information by the most appropriate system. Operational assessment and SESAR trials will lead to an update of standards expected in 2021 and initial operational capability planned for 2023, allowing transition from OLDI to the IOP/Flight Object concept.

2.7 With information exchanges at the core of TBO, there is an urgent need to progress the actual implementation of SWIM at a global scale. Not only with provisions related to the technical aspects of SWIM (e.g. data models and infrastructure), but with all provisions required to support the stakeholders in their development of producing and consuming information services, including the appropriate and proportional governance arrangements. Through European implementations, a solid experience has been gained on the establishment of a collaborative approach supporting the deployment of SWIM in Europe. It facilitates the development of early SWIM information services, as the ones already operationally used to improve ATM operations (e.g. extended arrival manager (E-AMAN), enhanced ATFM functions). Yet establishing a collaborative approach supporting this deployment which is acceptable by all stakeholders is a time-consuming activity. The lessons learned and initial SWIM elements developed in this context (e.g. regional standards on SWIM, proportional governance arrangements) could be considered as inputs for ICAO to facilitate further global SWIM implementation as an enabler for TBO.

2.8 ATM will accommodate new types of vehicles and interface with traffic management ‘regimes’ in which these new types of vehicles operate. Common to all types of operation is that they are all based on trajectories and the sharing of trajectory information in support of traffic management processes. TBO is therefore the common denominator between all the traffic management regimes including ATM.

3. CONCLUSION

3.1 TBO further details the ATM-wide concept of management by trajectory as outlined in the GATMOC. Through TBO the ATM system can make the paradigm change and achieve higher levels of performance than through an extrapolation of the current situation. Moreover, it will be possible to integrate new types of airspace users in an overall traffic management system. To obtain all these benefits higher levels of automation will be necessary which also necessitate to pro-actively consider the role of the human in the system. TBO relies on the expedited development and implementation of key enablers notably FF-ICE and SWIM.

3.2 The Conference is invited to agree on the following recommendations:

That the conference:

a) request ICAO to develop guidance material for global air traffic management (ATM)-system wide trajectory-based operations (TBO) transition serving existing and new types of vehicles, including assessment of amendments to ICAO provisions;

b) request ICAO to take benefit of existing State and regional ATM modernisation programmes on system-wide information management (SWIM) to expedite the progress on global SWIM provisions;

c) request ICAO to facilitate early implementation of key TBO enablers in particular SWIM and flight and flow information for a collaborative environment (FF-ICE);

d) request ICAO to recognise the need for increased levels of automation and collaborative decision making enabling TBO and promote the need to address the human dimension and change management processes in that context;

e) acknowledge the need for a global interoperable TBO and seamless ATM environment and it is recommended to initiate the development of provisions to ensure a globally interoperable TBO environment by taking into account regional developments.

— END —