

ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

- Agenda Item 6: Aeronautical navigation issues**
6.3 Amendments on aeronautical navigation subjects in relevant ICAO
: documents including the *Global Air Navigation Plan for CNS/ATM Systems*
(Doc 9750), Annex 10 — *Aeronautical Telecommunications* and other
documents as necessary

ENHANCED DATA INTEGRITY FOR RNAV AND GNSS-BASED OPERATIONS

(Presented by France)

SUMMARY

The safety of RNAV and GNSS-based navigation is highly reliant on the quality of the aeronautical data that are used by on-board systems. These data are originated by States, then processed through various organizations, and provided to the end-users. There are several applicable standards throughout the aeronautical data chain, notably ICAO Annex 15 and EUROCAE ED-76/RTCA DO-200A.

After a review of the current shortcomings identified regarding data integrity, that is a key-enabler of RNAV and GNSS-based operations, this working paper includes a review of the applicable standards, and points out the potential improvements of the ICAO material thought harmonization with industry standards and suggested additional guidance material.

Action by the conference is in paragraph 6.

¹ English version provided by France.

1. INTRODUCTION

1.1 As stated by the International Civil Aviation Organization (ICAO) in its Annex 15, the area navigation implementation, the development of global navigation satellite system (GNSS)-based operations and the widespread use of airborne computer-based navigation systems (notably flight management systems) have a significant impact on the role and importance of aeronautical information and data, which become an essential part in the overall safety of air navigation.

1.2 The ICAO thus stated that “each contracting State shall take all necessary measures to implement quality management” in the aeronautical information processes. In this framework, aeronautical data accuracy, resolution and integrity requirements were determined in order to support present and future air navigation operations in the context of the communications, navigation, and surveillance/air traffic management (CNS/ATM) concept. These initiatives are continuously completed by actions considered in the ANC Task No. AIS-9802 in the Technical Working Programme. Nevertheless, it has to be recognized that although the aim has been set up, the practices for reaching the assigned objectives, and the way to assess that they are satisfactorily met, have not yet been defined.

1.3 The aeronautical data that are used by on-board systems are derived from an “aeronautical data chain”, which covers the various processes applied to the data from their origination to their end-use. This chain involves various organizations which apply quality assurance processes stated in the existing applicable standards, notably ICAO Annex 15 for the origination of data and EUROCAE ED-76/RTCA DO-200A for the processing and release of aeronautical data.

1.4 The coexistence of several applicable standards that diverge in some parts, and the absence of guidance material for checking and assuring that the integrity of the data is maintained throughout the whole aeronautical data chain may lead to limitations in future navigation applications based on RNAV and GNSS.

2. CURRENT SHORTCOMINGS

2.1 During the first GNSS procedure and RNAV operation implementation trials, it has been shown that there are still many deficiencies in the quality of the aeronautical data compiled in airborne systems. These deficiencies include incorrect data and/or discrepancies between the data encoded in the computer-based navigation system and the data published in the Aeronautical Information Publication (AIP).

2.2 The main sources of errors that have been identified in early trials are the non-compliance by States with the data quality provisions included in ICAO Annex 15 during the origination phase, and the alteration of data during the various processes of the aeronautical data chain. The ICAO foresaw and encouraged the use of electronic means for data storage and transmission, but no specification have been included in the Standards and Recommended Practices (SARPs) to prevent flight critical data from being processed manually.

2.3 Although several initiatives have been launched to address the problem of data integrity, especially in the context of RNAV implementation, there is no coordinated system or applicable standard to make sure that the required levels of data integrity are met all the way of the aeronautical data chain, from

origination to end-use. Moreover, there is no current agreed methodology to assess the overall integrity of the data that are released by the aeronautical information services. It is considered that the successful implementation of RNAV and GNSS-based operations requires a resolution of these shortcomings in due course.

3. APPLICABLE STANDARDS

3.1 The ICAO Annex 15 — *Aeronautical Information Services* — and other related material (notably Annexes 4, 11, 14 and the AIS Manual) contain standards and recommendations on source data processing and handling. More specific details about aeronautical data and coordinates are included in the ICAO WGS-84 Manual. The Annex 15 also includes numerical requirements for the accuracy, integrity and resolution of aeronautical data. The numerical requirements have been set up to support RNAV and GNSS-based operations. Moreover, recommendations for the implementation of quality assurance procedures in aeronautical information services are included in this Annex.

3.2 The EUROCAE ED-76 / RTCA DO-200A — Standards for Processing Aeronautical Data — provides a minimum standard for the processing of aeronautical data. It includes guidance for compliance assessment and it provides users with assurance of the level of quality that can be associated with the processed data. In the framework of RNAV implementation, the major aeronautical data processing organizations are in the process of demonstrating compliance with the standard.

3.3 The EUROCAE ED-77 / RTCA DO-201A — Standards for Aeronautical Information — and the ARINC 424 — Navigation Data Base — are additional documents that contain recommendations for the correct process and format of the databases that are used in computer-based navigation systems.

4. POTENTIAL IMPROVEMENTS

4.1 The Annex 15 non-compliance problems (origination phase) mentioned in paragraph 2.2 highlight that despite the fact that this Annex includes good material about source data processing, there is an urgent need for further guidance material covering the acquisition of data from various sources (surveys, procedure design, etc.) and the potential applicable means for checking and ensuring that the data included in the AIP has the required level of integrity.

4.2 The coexistence of various applicable standards for the organisations involved in the aeronautical data chain may lead to some sort of confusion, especially because despite the efforts of the bodies involved in the preparation of these documents, there are still some discrepancies between the Industry and the ICAO data quality requirements for accuracy, integrity and resolution. It is therefore recommended that ICAO undertake as soon as possible a thorough review of the Annex 15 in order to solve these discrepancies.

4.3 In order to make sure that the required levels of data integrity are met all the way of the aeronautical data chain, from origination to end-use, it is recommended that ICAO develop a reference material for assessing the overall quality of aeronautical data. This would aim at detecting the data corruption events (alteration of the data by a given organisation without acknowledgement to the other involved organisations) in the aeronautical data chain.

4.4 The reference material should expand the current SARPs with a specific data management process (based on the one prescribed in ED-76/DO-200A), in order that a uniform and worldwide standard is applicable all the way in the aeronautical data chain.

4.5 The reference material would constitute a reference document for the assessment of the compliance of aeronautical data with the required levels of safety for the considered operations. As such, it could be the basis for subsequent audits applicable to all the organisations involved in the aeronautical data chain — including States — in line with the safety regulation policy through audits set up by the ICAO.

5. CONCLUSION

5.1 Aeronautical data integrity is to be considered as a key cornerstones of the implementation of RNAV and GNSS-based operations. Despite the existence of relevant standards applicable to States and Industry organisations involved in the aeronautical data chain, there is still an urgent need of harmonization between the reference documents, and of additional guidance for the origination phase whose responsibility remains with the States.

5.2 In the medium term, a reference document for the assessment of the data quality from origination to end-use is required. This material could subsequently be the basis for data audits covering all the aeronautical data chain, including the origination phase by States.

6. RECOMMENDATIONS

6.1 The conference is invited to:

- a) recommend that the ICAO urgently undertake;
 - 1) a thorough review of Annex 15 for harmonization of data quality requirements with the ones prescribed in other applicable standards;
 - 2) the development of a guidance material applicable to the origination phase, that would help the States to comply with the provisions of Annex 15; and
- b) endorse the principle of the preparation of a reference document (e.g. guidance material) for the assessment of the data quality from origination to end-use.