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ELEVENTH AIR NAVIGATION CONFERENCE

Montreal, 22 September to 3 October 2003

(DRAFT) REPORT OF COMMITTEE B ON AGENDA ITEM 6.4

The attached draft which constitutes a part of the report on Agenda Item 6 (sub-item 6.4) is presented for approval by Committee B for submission to the Plenary.

(12 pages)

Agenda Item 6: Aeronautical navigation issues

6.4 DIRECTIONS FOR FUTURE DEVELOPMENT OF AERONAUTICAL NAVIGATION SERVICES

6.4.1 Concept of using combinations of independent satellite navigation systems and their augmentations

6.4.1.1 The meeting was presented with the results of study carried out by the Global Navigation Satellite System Panel (GNSS) at request by the ICAO Air Navigation Commission. The study indicated that the increasing number of GNSS signals and constellations would offer significant benefits to civil aviation in terms of improved robustness and performance, simplification of GNSS ground architecture and alleviation of institutional concerns. The study also cautioned that the introduction of these new elements would raise some technical, economical and institutional issues.

6.4.1.2 The meeting recalled that information presented on GNSS development (Section 6.1 of this report refers) had indicated that GPS would be enhanced by providing additional signals and modernized satellites. It was also reported that modernized GLONASS satellites with improved characteristics would be added to the constellation. Further, a new constellation called Galileo which would provide three signals and a worldwide integrity function was being developed by Europe. It was understood that for any new signal and/or constellation, an additional time period of one to two years would probably be needed for the purpose of validation and certification by civil aviation authorities before new GNSS elements could be used for safety-of-life applications. This implied that the operational use of new signals and combined constellations service could start in the 2010 — 2015 time-frame.

6.4.1.3 The meeting recognized that the implementation of a multiplicity of different possible combinations of elements would result in overall system complexity and negative economic impact particularly on the user side and concluded that this can be avoided by the thorough assessment and selection of the most promising combinations for general implementation. Accordingly, the meeting developed the following recommendation:

Recommendation 6/12 — Development of guidance material on applications of new GNSS elements and their combinations

That ICAO, in developing standards for new GNSS elements and signals, address the issues associated with the use of multiple signals and their combinations, and develop guidance on the most promising combinations of GNSS elements.

6.4.1.4 The meeting was apprised that current GNSS avionics automatically select which satellites and augmentation elements to use. It was noted in this regard that State regulations could require or prohibit the use of certain future GNSS elements or their combinations in some airspaces. The meeting agreed that

such a situation could result in significant costs for users in terms of additional cockpit controls and procedures, crew training and maintenance support or become a safety issue due to human factors considerations. It also agreed that these potential repercussions require ICAO to encourage States, in their planning for implementation of GNSS services, to avoid limitations on the use of specific GNSS elements for institutional reasons. The meeting therefore developed the following recommendation:

Recommendation 6/13 — Potential constraints on using multiple GNSS signals

That States, in their planning for implementation of GNSS services, take full advantage of future benefits accrued from using independent core satellite constellations, other GNSS elements and their combinations, and avoid limitations on the use of specific system elements.

6.4.1.5 Having completed the review of the study results documented for the meeting's consideration, the meeting concluded that the document represented a useful overview of benefits from, and issues associated with the introduction of new elements of GNSS. Accordingly, the meeting agreed this overview to be included in Appendix D to the report on this agenda item.

6.4.2 GNSS services in the 960 - 1 215 MHz band

6.4.2.1 The meeting recalled that in its discussion on mitigation of GNSS vulnerabilities and benefits offered by the future development of GNSS, the introduction and use of additional "second civil" frequencies was emphasized on a number of occasions. In this regard, it was noted that the United States had decided to implement a second GPS civil frequency, known as L5, in the band 1 164.45 - 1 188.45 MHz. In parallel with this decision, Galileo signals would also utilize spectrum in the 1 164 - 1 215 MHz frequency range. The Russian Federation also reported plans to introduce an additional signal(s) in this frequency range as a part of the GLONASS modernization programme. These signals would be introduced in accordance with the ITU allocation of the 960 - 1 215 MHz band to the radionavigation satellite service (RNSS) on the conditions specified in ITU Radio Regulations, Footnote 5.328A (MOD-03) and Resolution 609 (WRC-03).

6.4.2.2 The meeting was reminded that the band 960 - 1 215 MHz, which continues to be allocated to the aeronautical radionavigation service (ARNS), was being heavily used by ICAO standardized distance measuring equipment (DME).

6.4.2.3 The meeting was made aware of a potential for interference to GNSS receivers in the 1 164.45 - 1 188.45 MHz band and to a lesser extent (due to the frequencies being used for special national allocations) in the 1 197.14 - 1 215 MHz band. The level and hence impact of interference was related to how many pulses transmitted by DME ground transponders in these portions of the band can interfere the aircraft GNSS antenna (the airborne interrogators do not operate at these frequencies).

6.4.2.4 The meeting agreed that, in cases where it is found that the DME stations may introduce unacceptable levels of interference into GNSS operations, ways of mitigating the interference, while maintaining the aeronautical radionavigation services, need to be considered. This could be achieved by:

a) modifying future DME installations to reduce the quiescent squitter rate to as near to 700 pulse pairs per second as practicable (Annex 10, Volume I, Chapter 3, paragraph 3.5.4.1.5.6 refers);

b) by making greater use of Y-channel DMEs; and

c) by re-assigning the current frequencies where practicable.

6.4.2.5 The meeting therefore developed the following recommendation:

Recommendation 6/14 — GNSS services in the 960 - 1 215 MHz band

That,

a) States be encouraged to plan the deployment of DMEs taking into account the need to minimize potential interference to GNSS services; and

b) an appropriate ICAO body be tasked to review the issues listed in paragraph 6.4.2.4 of the report on Agenda Item 6.

6.4.3 Review of Annex 10 SARPs for ground-based radio navigation aids in the light of present and planned GNSS services

6.4.3.1 The meeting was presented with the results of the preliminary review of Standards and Recommended Practices (SARPs) in Annex 10, Volume I undertaken by the GNSS Panel at the request of the Air Navigation Commission (ANC) in order to assess the need for updates of the document in the light of present and planned GNSS services. The objective of the review was to identify the areas where additional work should be initiated to investigate the impact of potential changes to the Standards and develop draft amendments to the Annex if necessary.

6.4.3.2 The meeting noted that future implementation of GNSS capable of providing global navigation coverage and area navigation (RNAV) capabilities in support of all phases of flight would overlay a number of capabilities and functions delivered by the existing radio navigation aids defined in Annex 10. The identified candidate parts with the potential to require modifications were generally those where SARPs may become redundant through the introduction of GNSS or alternatively where the Standards in their present form may prove problematic in the transition to satellite navigation.

6.4.3.3 The meeting also noted that, although these candidate parts were identified with the focus on GNSS-related aspects, a number of the potential updates were resulting from the increasing application of ground-based navigation aids in support of RNAV operations.

6.4.3.4 The meeting agreed that further work is required to investigate the feasibility of amending SARPs and guidance material in Annex 10, Volume I taking into account the potential for reduction of redundant navigation functionalities and protection considerations, and to develop draft amendments to the Annex as necessary. The issues to be addressed included:

a) general review of protection dates;

b) changes to DME specifications, taking account of the increasing use of this system in support of terminal RNAV operations and the use of DME/DME RNAV as a back up option to GNSS;

c) requirements for DME/P;

d) requirements for MLS/RNAV and updates of MLS specifications; and

e) updates of guidance material on DME, ILS and VOR service volumes and frequency planning.

6.4.3.5 Based on the above, the conference developed the following recommendation:

Recommendation 6/15 — Updating of SARPs for radio navigation aids in Annex 10, Volume I

That ICAO undertake a review of SARPs and guidance material in Annex 10, Volume I in the areas identified in paragraph 6.4.3.4 of the report on Agenda Item 6.

6.4.3.6 Noting the scope of Volume I of Annex 10, the meeting acknowledged close correlation and connection between Recommendations 6/14 and 6/15.

6.4.4 Enhanced data integrity for RNAV and GNSS-based operations

6.4.4.1 The meeting was made aware that, during the first GNSS procedure and RNAV operation implementation trials, deficiencies revealed in the quality of the aeronautical data in airborne systems had included errors and/or discrepancies between the data encoded in the computer-based navigation system and the data published in the Aeronautical Information Publication (AIP). It was noted that the main sources of errors were as a result of non-compliance with the data quality provisions in Annex 15 during the origination phase, and the alteration of data during the various processes of the aeronautical data chain.

6.4.4.2 It was further noted that, although ICAO had developed SARPs that govern various aspects of processing electronic aeronautical information, it could not prevent flight critical data from being processed manually. Although several initiatives had been launched to address the problem of data integrity, especially in the context of RNAV implementation, there were no coordinated system or applicable standards 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. The meeting was also informed of some discrepancies between the industry and the ICAO data quality requirements for accuracy, integrity and resolution.

6.4.4.3 In the discussion of issues raised, safety aspects of aeronautical data quality, particularly the integrity of data for RNAV and GNSS-based operations, were emphasized by many States and international organizations. In this regard, the meeting stressed an urgent need for ICAO to develop guidance material covering the acquisition of data from various sources, processing and assessment of the overall quality. It was suggested the material should also address 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. It was also suggested that the task of harmonization of Annex 15 data quality requirements and corresponding industry standards be endeavoured without delay.

6.4.4.4 In follow up to suggested actions, the meeting was made aware of work under way in ICAO to address the shortcomings tabled before the meeting. In particular, the meeting noted the progress of a task (AIS-9401) of the *Technical Work Programme (TWP) of the Organization in the Air Navigation Field* which included, among other things, the development of guidance material for the application by the aeronautical information services of the ISO 9000 standard series that would provide for the quality assurance of aeronautical information. The meeting was advised that this work was approaching the final stage and the Quality Management System Manual for AIS/MAP System was to be completed by the end of 2003. The meeting also noted that in accordance with a recommendation of the Global Navigation Satellite System Panel (GNSSP/4 Recommendation 3/4), the Navigation Systems Panel (NSP) had been requested to develop specific proposals towards harmonization of ICAO and industry standards for aeronautical data used in support of GNSS-based operations.

6.4.4.5 Having noted the above, the meeting developed the following recommendation:

Recommendation 6/16 — Completion of guidance material on application of data quality SARPs in Annex 15

That ICAO give high priority to the completion of guidance material for the data quality assurance including the data processing from origination to end-use.

6.4.5 Proposals for the future development of GNSS navigation services in the regions

6.4.5.1 In conclusion of its deliberations on aeronautical navigation issues, the meeting reviewed information on the Asia/Pacific Regional strategies for navigation services and proposals for the future regional development of GNSS navigation services.

6.4.5.2 The meeting noted the strategy for the provision of precision approach and landing guidance systems and the strategy for the implementation of GNSS navigation capability in the Asia/Pacific Region that had been adopted by the Fourteenth Meeting of the ASIA/PAC Air Navigation Planning and Implementation Regional Group (APANPIRG/14).

6.4.5.3 In regard to information and proposals developed and presented pursuant to Conclusion 11/54 of the Eleventh Meeting of the CAR/SAM Regional Planning and Implementation Group (GREPECAS/11), the meeting appreciated the progress in the trials and planning for GNSS navigation services. It agreed that the resulting experiences and challenges may be of general interest for other regions. These included activities in the development of regional satellite navigation service that can be progressed with small investments due to regionally coordinated efforts and committed participation of States. Human resource training and financing issues were noted as major challenges in implementing complex technology systems such as GNSS.

6.4.5.4 The meeting noted that ICAO provided assistance to States for the implementation of CNS/ATM systems on continuous basis under three different mechanisms. These included Special Implementation Projects, Technical Cooperation Projects and International Financial Facility for Aviation Safety. In addition, ICAO undertook periodical technical visits to States, developing regional guidance material and conducting regional workshops.

6.4.5.5 In concluding its discussions on aeronautical navigation issues, the meeting once again, in line with its Recommendation 6/1, emphasized the need for ICAO, States, airspace users and other parties concerned to continue work towards safe and efficient global navigation systems for all phase of flight.

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