



INTERNATIONAL CIVIL AVIATION ORGANIZATION
WESTERN AND CENTRAL AFRICAN OFFICE

Sixth Meeting of the APIRG Communications, Navigation
and Surveillance Sub-group (CNS/SG/6)

Dakar, Senegal, 18–22 May 2015

Agenda Item 4: Review of the status of implementation of CNS/SG Work Programme and related Task forces/Working Groups as assigned by APIRG

Status of core GNSS constellations and of GNSS Augmentation systems

(Presented by the Secretariat)

Summary

This paper presents information on the latest developments on GNSS as discussed during the 12th ICAO Air Navigation and encourages AFI States to implement its relevant Recommendation

Action by the meeting is at **paragraph 3**.

References

- Doc 9750

This Working Paper is related to Strategic Objectives: A

1. Introduction

The ICAO 12 Air Navigation conference was held in Montreal, Canada from 19 to 30 November 2012. The conference examined under Agenda item **6: Future direction (§ 6.5)** the issues related to the Global Navigation Satellite System (GNSS) and its trend of evolution and formulated two Recommendations.

2. Discussion

2.1 Status of core GNSS constellations

Under this item, the Conference noted information on the implementation status of global navigation satellite system (GNSS) constellations and augmentations systems, and considered a number of related implementation issues.

The Conference was informed that the United States is currently deploying modernized global positioning system (GPS) satellites with L1C/A and L5 signals and improved military encrypted signals that will enable civil and authorized State aircraft with modernized equipment to remove ionosphere induced errors and take advantage of increased performance and robustness.

The Conference was informed that the Russian GLObal Navigation Satellite System (GLONASS) was operating with a stable constellation of twenty-four GLONASS-M satellites, with additional back-up satellites. In addition, the Russian Federation is continuing its work to develop a new generation of GLONASS-K satellites. In-orbit tests are currently being conducted on an experimental GLONASS-K satellite. The ground control system is also being improved.



The Conference noted that Galileo is a GNSS constellation that is being developed by the European Union in cooperation with the European Space Agency. The first four satellites have already been successfully launched, and it is expected that 18 satellites will be operational by 2015, enabling the provision of initial services in combination with GPS and other constellations. It is planned that the Galileo constellation will be fully deployed by 2020.

The Conference also noted information on the BeiDou system, a GNSS constellation developed and operated by China. The deployment of the system is progressing as scheduled. The second phase of development has just been completed, supporting a position, navigation and timing (PNT) service for China and the surrounding areas. According to the schedule, full global deployment of the constellation will be completed by 2020.

2.2 *Satellite-based augmentation system (SBAS)*

The Conference was provided information on the implementation status of several satellite-based augmentation systems (SBAS). In particular, it was noted that the critical (Safety-of-Life) service of the European Geostationary Navigation Overlay Service (EGNOS) system was declared operational for aviation in 2011, and offered to ICAO for use by the civil aviation community. Furthermore, the Conference noted the progress made in the deployment of the GPS Aided Geo Augmented navigation (GAGAN) system developed by India, with the completion of the final system acceptance test and the inception of the certification process.

2.3 *Multi-constellation/multi-frequency GNSS*

Noting the information on implementation status of new and enhanced constellation and augmentation systems, the Conference acknowledged that GNSS is currently undergoing a significant evolution. As new constellations are deployed, and existing constellations are enhanced, signals from multiple constellations broadcasting in multiple frequency bands are becoming available. These developments lead to technical performance improvements, which create the potential for achieving significant operational benefits.

At the same time, it was noted that the introduction of multi-constellation, multi-frequency GNSS entailed a number of new technical and regulatory challenges beyond those already associated with current GNSS implementation.

With regard to regulatory challenges, the Conference discussed the issues associated with mandating the use of specific GNSS elements. While in some cases mandates might expedite the fruition of the benefits deriving from the use of a specific system or technology, the meeting recognized that a performance-based approach is in principle preferable in the GNSS case.

The meeting acknowledged that some States may mandate equipage of aircraft with a specific GNSS constellation for various reasons not necessarily associated with navigation performance only. In such cases, the consensus of the meeting was that any State intending to introduce such mandates should limit them to aircraft operators for which it is the State of the operator.

The meeting's attention was also drawn to the additional difficulties that would necessarily arise if different mandates for specific GNSS elements were introduced in different States or regions. In particular, it was noted that such a situation could result in significant costs for users in terms of additional cockpit controls and procedures, crew training and maintenance support, and possibly raise human factors concerns.

In order to limit such consequences, content and timelines for the implementation of potential mandates would need to be coordinated at the regional and inter-regional level in order to reduce the implementation burden on airspace users.

The Conference concluded that the potential benefits of the on-going evolution of GNSS towards a multi-constellation, multi-frequency scenario could only be fully secured if ICAO, States and aircraft operators take action to overcome the associated challenges.

On the basis of the discussions, the following recommendations were accepted by the Conference:



Recommendation 6/5 – ICAO work programme to support global navigation satellite system evolution

That ICAO undertake a work programme to address:

- a) Interoperability of existing and future global navigation satellite system constellations and augmentation systems, with particular regard to the technical and operational issues associated with the use of multiple constellations;
 - b) Identification of operational benefits to enable air navigation service providers and aircraft operators to quantify these benefits for their specific operational environment; and
 - c) Continued development of Standards and Recommended Practices and guidance material for existing and future global navigation satellite system elements and encouraging the development of industry standards for avionics.
- 6.5.14 On the basis of the discussions, the following recommendation was accepted by the Committee:

Recommendation 6/6 – Use of multiple constellations

That States, when defining their air navigation strategic plans and introducing new operations:

- a) Take advantage of the improved robustness and availability made possible by the existence of multiple global navigation satellite system constellations and associated augmentation systems;
- b) Publish information specifying the global navigation satellite system elements that are approved for use in their airspace;
- c) Adopt a performance-based approach with regard to the use of global navigation satellite system (GNSS), and avoid prohibiting aircraft use of GNSS elements that are compliant with applicable ICAO Standards and Recommended Practices;
- d) Carefully consider and assess if mandates for equipage or use of any particular global navigation satellite system core constellation or augmentation system are necessary or appropriate;

That aircraft operators:

- e) Consider equipage with GNSS receivers able to process more than one constellation in order to gain the benefits associated with the support of more demanding operations

3 Actions by the meeting

- a) The meeting is invited to:
- b) Take note of the Information given above
- c) Implement Recommendations 6/5 and 6/6 of the ICAO 12 Air Navigation Conference
- d) Revise if necessary the AFI GNSS Strategy in consideration of the evolving GNSS technology and systems