ANI/WG/2 — WP/16
29/05/15

Second NAM/CAR Air Navigation Implementation Working Group Meeting (ANI/WG/2)
Puntarenas, Costa Rica, 1 to 4 June 2015

Agenda Item 4 **Follow-up on the NAM/CAR Regional Performance Based Air Navigation Implementation Plan (NAM/CAR RPBANIP)**
4.1 Progress reports of the Task Forces and the ANI/WG

GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS) ACTIVITIES IN SUPPORT OF PERFORMANCE-BASED NAVIGATION (PBN)/AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST (ADS-B) IMPLEMENTATION

(Presented by the Secretariat)

EXECUTIVE SUMMARY

This working paper proposes the need to define and work toward implementing actions for planning and implementation of GNSS activities in support of PBN and ADS-B implementation.

Action:	The suggested action is presented in Section 3
Strategic Objectives:	• Safety • Air Navigation Capacity and Efficiency
References:	• ICAO Cir 321, Guidelines for the implementation of GNSS longitudinal separation minima • Annex 10 — Aeronautical Telecommunications. • ICAO Global Navigation Satellite System (GNSS) Manual (Doc 9849) • ICAO PANS ATM

1. Introduction

1.1 In 1996, the International Civil Aviation Organization (ICAO) endorsed the development and use of GNSS as a primary source of future navigation for civil aviation. ICAO noted the increased flight safety, route flexibility and operational efficiencies that could be realized from the move to space-based navigation. Since then, air navigation service providers (ANSPs), airline operators and avionics/receiver manufacturers have engaged in an ambitious effort to develop GNSS, related augmentation systems, airborne receivers and ground infrastructure and to implement procedures, equip aircraft and train pilots in the use of satellite navigation.

1.2 GNSS provides significant improvements in relation to conventional radio navigation installations because of the global availability and accuracy of the GNSS signal. The potential for using GNSS for the application of separation was identified by the ICAO Separation and Airspace Safety Panel (SASP), publishing the first minima, for GNSS longitudinal separation, in November 2007, and the second we published in 2014 related to GNSS lateral separation minima.

1.3 PBN is being implemented by the States with the assistance of the ANI/WG. ADS-B is a key Air Navigation element under planning and implementation. Both PBN and ADS-B are applications that are dependant of the quality and availability of the GNSS signal.

2. Discussion

2.1 As a result of the large number of aircraft equipped with instrument flight rules (IFR)-certified GNSS equipment for navigation and its potential use for separation in the procedural environment, widespread implementation of performance-based navigation (PBN) is expected.

2.2 GNSS is global in scope and fundamentally different from traditional navigation aids (NAVAIDs). It has the potential to support all phases of flight, resulting in a seamless global navigation guidance system. GNSS provides accurate guidance in remote and oceanic areas where it is impractical, too costly or impossible to install traditional NAVAIDs. It also guarantees that all operations are based on a common navigation reference. To meet the performance criteria for aviation, GNSS must be able to ensure integrity, accuracy, availability and continuity to specified levels.

2.3 The ICAO Annex 10 Volume 1 and the *ICAO Global Navigation Satellite System (GNSS) Manual* (Doc 9849) provides the necessary overview of GNSS positioning in the context of using GNSS as a basis for separation minima in a procedural environment.

2.4 ICAO circular 321 is to provide guidance for applying the global navigation satellite system/distance measuring equipment (GNSS/DME) separation minima. Similarly ICAO Circular 322 provides guidance on applying the global navigation satellite system (GNSS) lateral separation minima which is based on the VHF omnidirectional radio range (VOR) lateral separation minima.

2.5 With the 6 Amendment to the 15th edition of the PANS-ATM effective 14 November 2014, the following were introduced: Amendment to definitions; controller pilot data link communication (CPDLC) procedures; in-trail procedure (ITP); automatic dependent surveillance — contract (ADS-C) procedures; volcanic ash cloud, strategic lateral offset procedures (SLOP); 9.3 km (5 NM) terminal separation based on RNP, PBN lateral separation and VOR/GNSS lateral separation and consequential ATC phraseologies. was amended to included 9.3 km (5 NM) terminal separation based on RNP, PBN lateral separation and VOR/GNSS lateral separation

GNSS Service Considerations

2.6 Receiver autonomous integrity monitoring (RAIM) provides integrity monitoring of GPS for aviation applications. In order for a GPS receiver to perform RAIM or fault detection (FD) functions, a minimum of five visible satellites with satisfactory geometry must be visible to it. The RAIM function performs consistency checks between position solutions obtained with various subsets of the visible satellites. The receiver provides an alert to the pilot if the consistency checks fail. Because of geometry and service maintenance, RAIM is not always available.

2.7 Fault detection and exclusion (FDE) -an enhanced version of RAIM, uses a minimum of six satellites not only to detect a possible faulty satellite, but to exclude it from the navigation solution so that the navigation function can continue without interruption. The goal of FD is to detect the presence of a positioning failure. Upon detection, proper fault exclusion determines and excludes the source of the failure, without necessarily identifying the individual source of the problem, thereby allowing GNSS navigation to continue without interruption. Availability of RAIM and FDE will be slightly lower for mid-latitude operations and slightly higher for equatorial and high-latitude regions due to the nature of the orbits. The use of satellites from multiple GNSS constellations or the use of satellite-based augmentation system (SBAS) satellites as additional ranging sources can improve the availability of RAIM and FDE.

2.8 RAIM prediction. GNSS differs from traditional navigation systems because the satellites and areas of degraded coverage are in constant motion. Therefore, if a satellite fails or is taken out of service for maintenance, it is not immediately clear which areas of the airspace will be affected, if any. The location and duration of these outages can be predicted with the aid of computer analysis and reported to pilots during the pre-flight planning process.

2.9 In order to be able to implement a PANS-ATM separation minimum, a regional, State or local safety assessment must be completed. When undertaking this activity, reference should be made to the requirements detailed in Annex 11 — Air Traffic Services (Section 2.27), the Procedures for Air Navigation Services — Air Traffic Management (PANS-ATM, Doc 4444) (Section 2.6), and the guidance material contained in the ICAO Safety Management Manual (SMM) (Doc 9859).

GNSS implementation status

2.10 WAAS and LAAS systems are implemented in United States. WAAS has operational coverage in North America including Mexico.

2.11 A SBAS study has been completed for the CAR/SAM Regions as detailed in an IP of the ANI/WG/02 Meeting.

2.12 Some GBAS studies have been conducted in the CAR region ex. in Guatemala.

2.13 For the 1st semester of 2016, ICAO had planned a workshop on GNSS implementation for supporting PBN.

3. Suggested Action

3.1 The Meeting is invited to:

a) take note of the importance and need for planning actions for GNSS Regional implementation;

b) agree on actions for implementing GNSS elements;

c) PBN and ADS-B TFs to consider the necessary coordination on implementing GNSS in the Region supporting the scheduled GNSS workshop; and

d) take any action as deemed necessary.

— END —