International Civil Aviation Organization

Twenty Seventh Meeting of the Communications/ Navigation and Surveillance Sub-group (CNS SG/27) of APANPIRG

Bangkok, Thailand, 28 August – 01 September 2023

Agenda Item 6: Navigation

6.4 Other navigation related issues

RESEARCH ON BDS ISM BROADCAST SCHEME

(Presented by China)

SUMMARY

This paper provides the status of Advanced Receiver Autonomous Integrity Monitoring (ARAIM) Integrity Support Message (ISM), including the descriptions of ISM and ISD, the ISM design of core constellation, and the research on BeiDou Navigation Satellite System (BDS) ISM broadcast scheme.

1. INTRODUCTION

1.1 Advanced Receiver Autonomous Integrity Monitoring (ARAIM) is a satellite navigation capability that provides the integrity of highly available, continuous, and accurate GNSS based Position, Navigation, and Time services. The NSP JWG8/WP37 presented the fifth draft of ARAIM Standards and Recommended Practices (SARPs), which was further updated as the validation version in subsequent meetings, including NSP JWGs9, GSWG4, NSP7, and JWGs10.

1.2 Integrity Support Data (ISD) is a set of parameters that describes the accuracy and integrity of satellite signals in space for a specific constellation. ISD is encapsulated in an Integrity Support Message (ISM) and transmitted to aviation users, where it is utilized as the input of ARAIM onboard receiver algorithm.

1.3 Compared with default values, broadcasted ISD has the potential to enhance the ARAIM performances. The broadcasted ISD can be included in one or multiple ISMs. GPS and Galileo have specified their ISM broadcast schemes.

1.4 This paper presents the status of ARAIM ISM and the research on BDS ISM broadcast scheme.

2. DISCUSSION

ISM Design of Core Constellation

2.1 GPS published a preliminary ISM message format and ISM interface specifications. GPS plans to embed ISM in its navigation message and has defined message formats for broadcasting ISM on L1C and L5 frequencies. If the transmitted ISM/ISD values from GPS are unavailable for any reason, the onboard receiver will utilize default values for horizontal ARAIM.

2.2 Galileo has completed the development of ISM message format and ISM receiver processing methods. Additionally, progress has been made in the formulation of ISM interface specifications and the development, testing, and performance verification of ARAIM receiver prototypes. Galileo ISM is transmitted by introducing a new I/NAV word type called Word Type 22 (WT22) in navigation message. The Galileo ISM Generator (ISMG) is responsible for generating ISM in accordance with the WT22 format.

Research on BDS ISM Broadcast Scheme

2.3 Currently, there is ongoing research aimed at broadcasting BDS ISM to aviation users through Low Earth Orbit (LEO) satellites, as depicted in Figure 1. In this proposed scheme, BDS observations are collected by the ground monitoring network and transmitted to the ISM generation system through a dedicated civil aviation network. The ISM generation system calculates ISD parameters by establishing a unified spatiotemporal reference, extracting relevant error components, and running the ISM generation algorithm. The estimated ISD parameters are packaged into ISM and uploaded to LEO satellites via the ground uplink stations. Through inter-satellite links, the LEO satellites enable information sharing and broadcast ISM to users worldwide. The aviation onboard communication terminal receives and decodes the ISM, forwarding it to the navigation terminal. The navigation terminal integrates BDS observations and ISM to execute the ARAIM onboard algorithm, thereby achieving integrity monitoring.

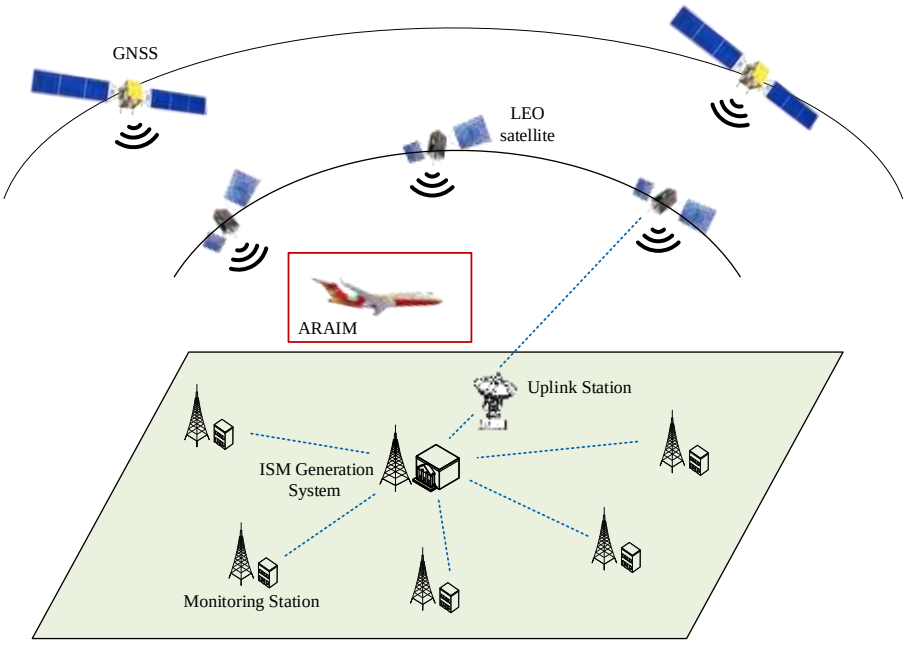

Figure 1 Research on the BDS ISM broadcast scheme

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the status of ARAIM ISM and the research on BDS ISM broadcast scheme in this paper.

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