International Civil Aviation Organization

THE SIXTH MEETING OF THE ASIA/PACIFIC GBAS/SBAS IMPLEMENTATION TASK FORCE (GBAS/SBAS ITF/6)

(Bangkok, 7- 9 May 2024)

Agenda Item 3: Updates from States/Administrations about GBAS/SBAS Implementation

GNSS RFI monitoring service by JCAB in Japan

(Presented by Hiroki Tanaka)

SUMMARY

Since 2020, Japan has been providing centralized information on GNSS navigation in the Fukuoka FIR through JCAB. The purpose of this is to quickly understand the current state of GNSS within the country and provide users with accurate and comprehensive information on the impact of GNSS navigation based on SARPs and GNSS manuals. This IP introduces JCAB's efforts to solve problems in the field of navigation.

1. INTRODUCTION

1.1 Japan Civil Aviation Bureau (JCAB) established the Network Performance Assessment Center (NPAC) in 2020 for the mission of centrally monitoring, analyzing and assessing service levels of CNS as the core of CNS performance management, which is an important key to realizing PBO. This paper introduces the performance monitoring of GNSS conducted by NPAC.

1.2 NPAC collects GNSS signals by GPM system and provides the following three services to users (Figure 1).

a) GNSS Performance Prediction Service providing availability forecasts for ABAS and SBAS

b) GNSS Performance Monitoring Service providing information on the impact on operations utilizing GNSS.

c) GNSS Performance Analysis and Evaluation Service conducting analysis and evaluation of GNSS performance for safe and continuous utilization of GNSS.

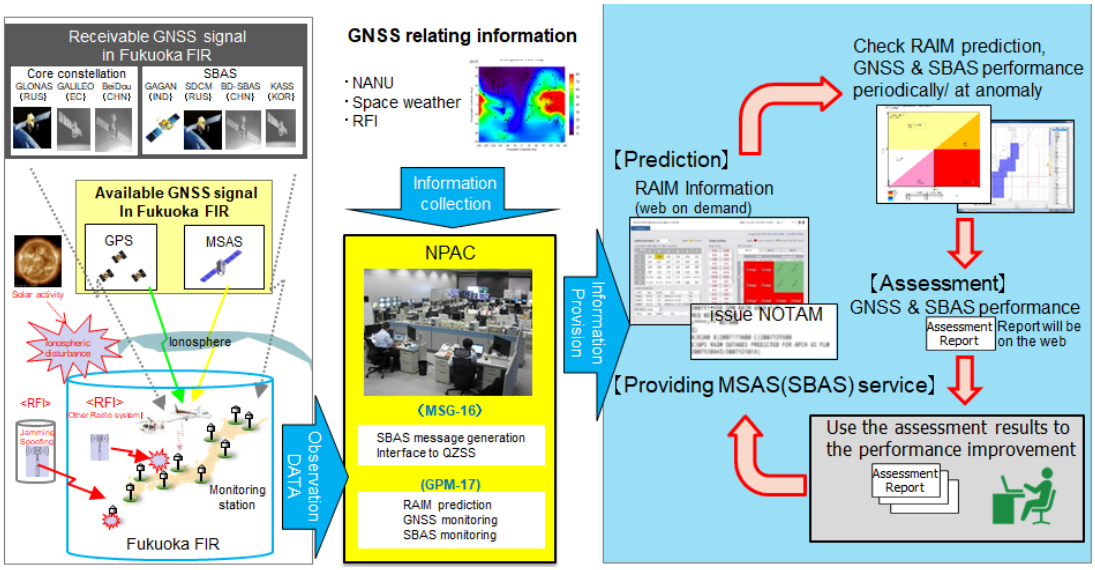

Figure 1. Services provided by NPAC

2. DISCUSSION

2.1GNSS performance prediction service and challenges

2.1.1 GNSS performance prediction service predicts the navigation system's outage at any point for aircraft using PBN by using GPS satellite orbit information and MSAS augmentation information, etc. (Figure 2). If the aircraft is equipped with an ABAS (GPS-RAIM) receiver, it is a simple configuration as GNSS. On-board availability calculations are based solely on GPS placement and do not depend on radio wave propagation behavior or GPS positioning accuracy. For this reason, it is relatively easy to match calculations made by airborne equipment with predictions made by ground equipment.

2.1.2 However, if the aircraft is equipped with an SBAS receiver, it's more complicated than ABAS. On-board availability calculations must consider augmentation information that depends on radio wave propagation behavior of the day and GPS positioning accuracy. For this reason, it is very difficult to match calculations made by airborne equipment with predictions made by ground equipment. The SBAS prediction information output by the current GPM causes discrepancies with the real-time SBAS availability status in spring and autumn, which are the seasons when the influence of the ionosphere increases (i.e., prediction errors). Especially last spring, the deterioration of prediction accuracy could be seen, and this discrepancy was particularly pronounced in the southern regions with poor ionospheric conditions.

2.1.3 As mentioned above, Japanese prediction service faced challenges related to the behavior of the ionosphere. Japan has been improving the performance of MSAS which is necessary to ensure smooth LP/LPV operation after the performance improvement. For this reason, we have been working to clarify the situation by analyzing the prediction relevance rate and operation rate in advance.

2.1.4 We are going to continue implementing similar evaluations at each LP/LPV-compliant airport. If the availability approaches near 100%, such initiatives may no longer be necessary. However, as long as the performance of MSAS augmentation data is not sufficient, we believe it is necessary to continue these efforts. Regarding the scheme and operational framework of GNSS prediction, we recognize that the procedures may vary depending on each country's situation.

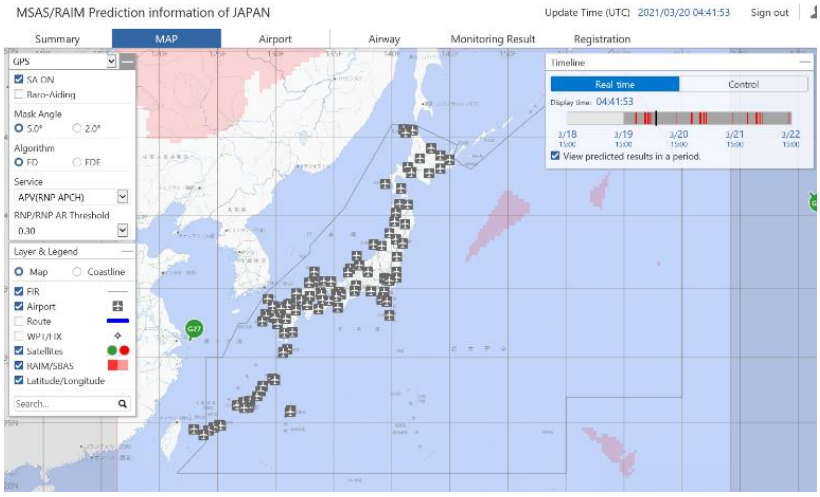

Figure 2. Example of MSAS/RAIM prediction service display

2.2 GNSS performance monitoring service and challenges

2.2.1 GNSS performance monitoring service collects data real timely such as GNSS monitoring data or ADS-B information from the aircrafts on en-route by 10 GPM(GNSS Prediction and Monitoring equipment which indicates in red and green) monitoring sites and 13 MSG(MSAS Signal Generation and operation equipment which indicates in orange) monitoring sites installed all over Japan, and monitors the navigation performance degradation of the navigation system and the situation status of the L1 frequency. And it enables to confirm the effect to navigation system by monitoring interference or jamming from outsiders, which influences to GNSS performance (Figure 3).

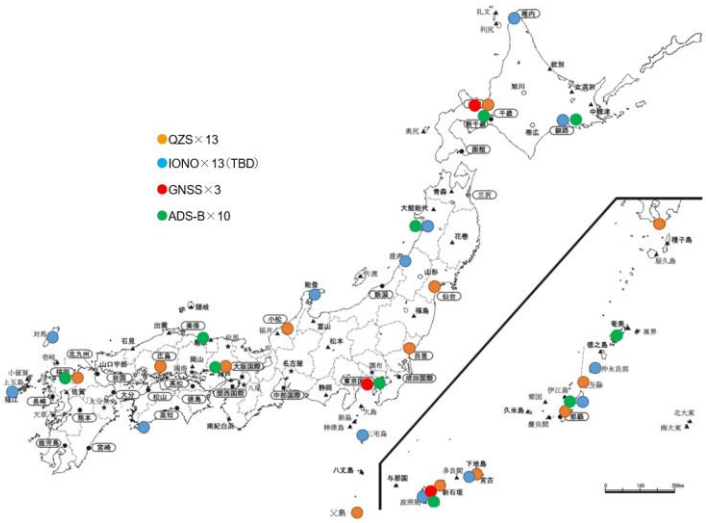

Figure 3. Antenna installation position

2.2.2 NPAC aims to establish a framework to detect the situation accurately and provide the information to users in the event of RFI to GNSS, to minimize confusion. Based on GNSS Manual (chapter 7.12.4), NPAC takes appropriate action in case of GNSS related failures.

2.2.3 As a response procedure when the impact of solar activity or man-made interference is suspected, NPAC organized the response method when RFI occurs and created the "GNSS Interference Response Flow" (Figure. 4). It considers cooperating organizations, interference monitoring procedures, trends in space weather information, detection procedures, NOTAM standards, responses to space weather advisories. (Note 1)

Note1. Space weather advisory: ICAO has started to provide space weather advisory since Nov.2019.

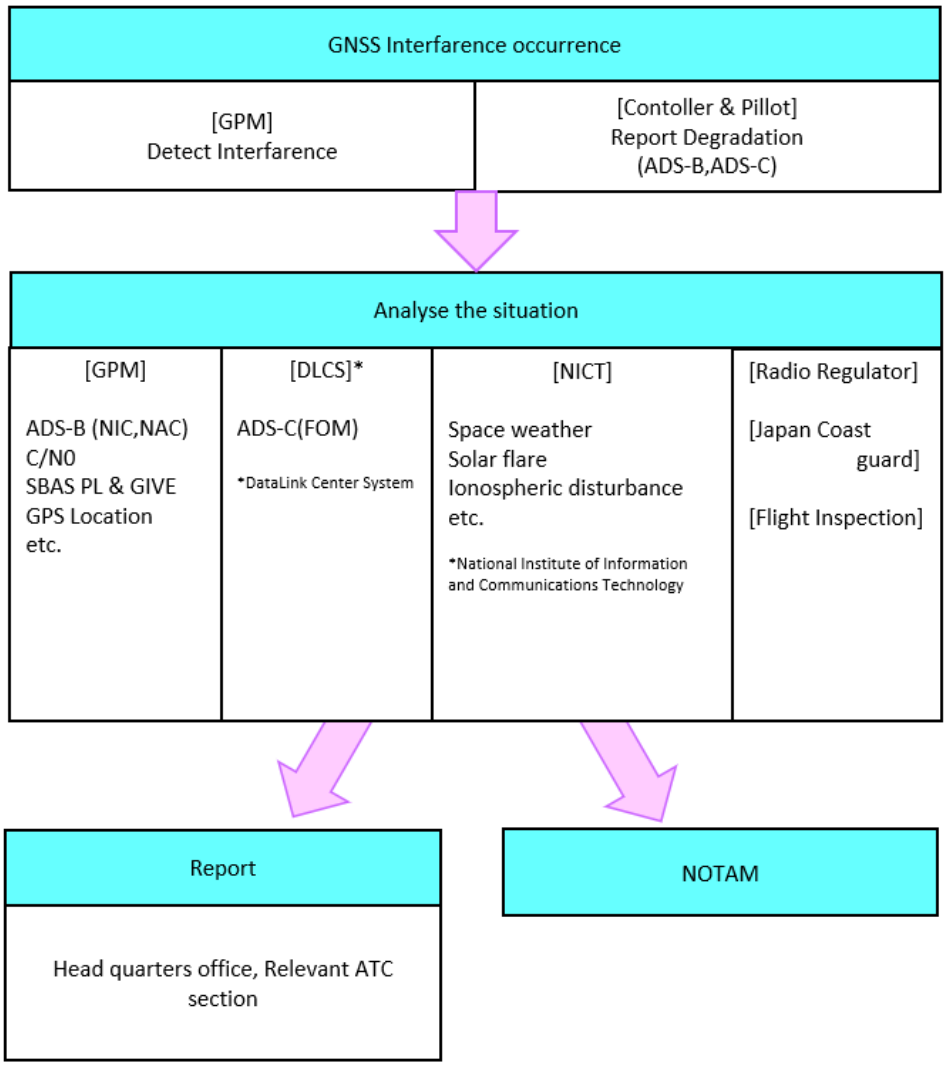

Figure 4. GNSS interference response flow

NPAC held the meeting with Japanese 13 airlines to introduce the GNSS prediction and monitoring activity. At the meeting, NPAC presented the draft RFI reporting form, gathered opinions, and requested cooperation in sharing information in the event of an RFI. NPAC tries to establish the system to cope with the RFI for the GNSS as the Team Japan.

NPAC has disseminated the version that reflects airline opinions as the first version (July 11, 2023), and the report form has been in operation since August 1. (Reporting is optional)

The form is for filling in information related to the NPAC investigation, such as aircraft information, point of occurrence, and interference situation.

NPACv20230802

Problem Reports for ADS-B and GNSS

This form is to report to Network Performance Assessment Center (NPAC), JCAB, which is an RFI-compliant organization, when operator detects events such as deterioration of navigation accuracy, ADS-B OUT EICAS message, and GNSS OUTAGE, suspected to be caused by RFI (Radio-frequency interference) detected by operators in the airspace of Fukuoka FIR.
Based on your information, NPAC will estimate the scope of the impact of RFI and issue information as NOTAM as necessary. If you face such events during the flight, please fill in the details in the form as far as you know and report it to NPAC by email.

The report is voluntary, but your cooperation would be greatly appreciated.

Person in charge of problem report			
Company Name	Your name	telephone number	E-mail address

Aircraft Information					
Flight number	Aircraft type	registration	Arrival Airport	MODE-S Address	ADS-B

ADS-B OUT EICAS ADVISORY Information				
	Occurrence/Recovery Date and time (UTC)	Point (Location) ① or ② information		Altitude (FL or ft)
		① WAY POINT name/bearing/distance	② Latitude/Longitude	
Occurrence				
Recovery				

※ Latitude and longitude must be expressed in degrees, minutes, and seconds.

to control, etc. Reporting	Name of the contact person	Details of the problem (free description)
With / Without		Example: ADS-B OUT EICAS message occurred at the occurrence point. It kept Continuous and intermittent until recovery point. Switched to another navigation method (DME/DME, etc.). ADS-B was lost at the occurrence point. Detoured to another airport. etc

Contact (24H): Performance Evaluation Air Traffic Control Technical Officer,
NPAC, Control Technology Division, Civil Aviation Bureau
TEL: 0294-72-9107 Mail: cab-cns.pm@mlit.go.jp

Figure 5. “Report format”

2.3 GNSS performance evaluation service and challenges

2.3.1 NPAC will monitor, record GNSS data and perform performance evaluation based on ICAO SARPs (V1 2.1.4.2, ATT-D-11, 12, Requirement for Signal in Space) and GNSS manual (7.8). The results of the analysis are summarized in performance evaluation reports on an annual basis.

2.4 NPAC is currently publishing the MSAS performance evaluation report online. By widely disclosing the performance of MSAS, we believe that we can further contribute to the promotion of seamless SBAS use on a global scale.

— END —

3. ACTION REQUIRED BY THE MEETING

3.1 The meeting is invited to: amend as appropriate

a) note the information contained in this papers; and
b) discuss any relevant matters as appropriate.

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