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

GBAS Status Update in Japan

(Presented by Japan)

SUMMARY

This paper presents an update to GBAS development in Japan.
Japan Civil Aviation Bureau (JCAB) installed the first GBAS at Tokyo international airport (HND) and is conducting CAT-I trial operation. The goal of the trial operation is near.
The Electronic Navigation Research Institute (ENRI) has contributed to the improvement of GAST-D performance in low latitude regions. Currently, ENRI is engaged in research and development activities related to GBAS, including the development of the DFMC GBAS concept and advanced operations with GBAS.

1. INTRODUCTION

1.1 Japan developed an ionospheric threat to define the anomalous ionospheric conditions in the low magnetic latitude region, and developed an integrity monitoring mechanism with an ionospheric field monitor (IFM) in order to address the ionospheric issues in the process of R&D and manufacturing/implementation of GBAS in Japan.

1.2 Japan Civil Aviation Bureau (JCAB) installed the first GBAS at Tokyo international airport (HND), and is conducting CAT-I trial operation.

1.3 Japan is conducting R&D on CAT-III GBAS with the GBAS prototype at Ishigaki airport (ISG).

1.4 Japan is also conducting R&D on Dual-Frequency and Multi-Constellation (DFMC) GBAS.

2. CAT-I GBAS

2.1 Activity Result

2.1.1 Japan started R&D on GBAS, and installed the first prototype at Kansai international airport (KIX) in 2011.

2.1.2 Japan developed ionospheric threat model in order to meet the requirements for CAT-I operations in the low magnetic latitude region.

2.1.3 Japan developed IFM (ionospheric field monitor) to mitigate the navigation error due to the ionospheric abnormality.

2.1.4 JCAB awarded NEC Corporation a contract to manufacture and install GBAS at HND in 2016.

2.1.5 Operational trial of GBAS approaches started at HND in July 2020.

2.1.6 NEC GBAS implements algorithms that can be handled severe ionospheric environments.

2.2 Operational Trial at Tokyo Haneda

2.2.1 CAT-I GBAS approach procedures may be used for runway 34R and 34L of HND.

2.2.2 Applicable time is from 14:00 to 21:00UTC. (23:00 to 06:00JST)

2.2.3 Two Japanese airlines, ANA and JAL, conducted GLS approaches. Aircraft operated by pilot who has provability to operate CAT I approach with GBAS landing system may participate in the operational trial. Details of the conditions are provided in AIP SUP NR038/21 issued on 25 March 2021.

2.2.4 Pilot feedbacks indicated GLS provided a more stable approach compared to ILS.

2.2.5 JCAB observed good flight inspection data necessary for approach minimum reduction.

2.2.6 JCAB is considering and coordinating the start of GBAS operations, including revisions to the final approach procedure.

2.2.7 The future challenge is to establish the skills and procedures necessary to periodically validate and update the ionospheric model.

3. CAT-III GBAS

3.1 Japan developed a CAT-III GBAS prototype for R&D in 2014.

3.2 Japan contributed to ICAO activities on CAT-III GBAS.

4. DFMC GBAS

4.1 Japan started R&D on DFMC GBAS in 2015.

4.2 DFMC GBAS will improve availability based on multi-constellation, and will mitigate the threat of ionosphere based on dual frequencies as well.

4.3 The testbed of DFMC GBAS developed and deployed at Ishigaki, Japan in 2019. Japan will contribute to ICAO activities on DFMC GBAS.

5. GBAS R&D STATUS IN JAPAN

5.1 Electronic Navigation Research Institute (ENRI) has been conducting researches on the DFMC GBAS since 2015 to contribute to the DFMC GBAS standardization activities by ICAO. ENRI operates a DFMC GBAS testbed installed at ISG which consists of five DFMC reference receivers installed in the airport field and a VDB transmitter (Figure 1). The testbed can generate draft Type-23 and 50 Messages (MT-23/50) proposed with the draft standards of GAST E. The testbed is supported by instruments to observe ionospheric conditions including GNSS scintillation receivers and an all-sky airglow imager. The airborne experiment subsystem process draft MT-23/50 generated by the testbed to support GAST E. The flight data collection campaigns were conducted in March and October 2022, April and October 2023, and March 2024. Ground and airborne GNSS data were successfully collected including those under ionospheric severe ionospheric conditions. More details of the campaign is reported in a separated information paper to this meeting. Next flight data collection campaign is planned in October 2024.

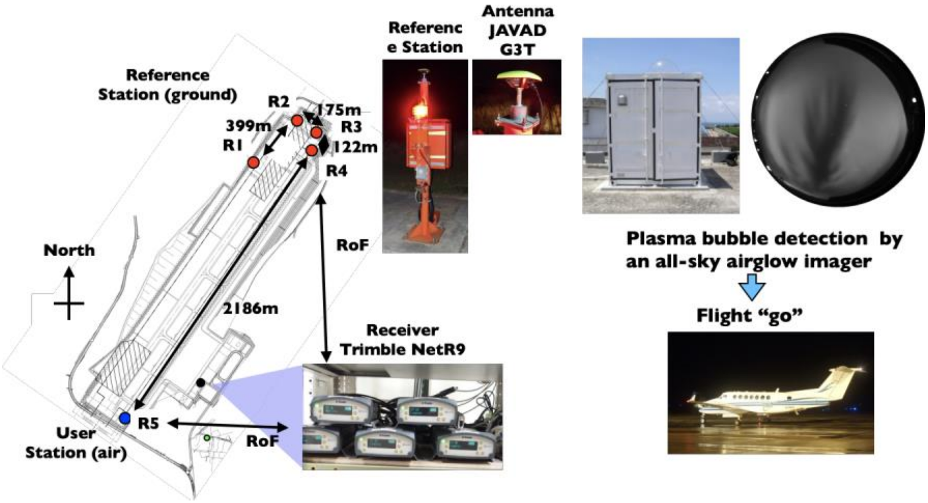

Figure 1. DFMC GBAS testbed at ISG and a plan
for flight data collection under ionospheric disturbances.

5.2 GAST D performance enhancement in challenging ionospheric conditions such as the low latitude region is of great interest of Japan. ENRI has been contributing to the GWG IGM ad hoc activities. Main focuses are scintillation effects on the GAST D integrity monitors and better ionospheric threat definition. Ionospheric gradient data collection is being conducted in collaboration with research institutes and organizations in Indonesia, Thailand and Vietnam. More and more ionospheric gradient events are being recorded as the solar activity gets higher and higher.

5.3 ENRI supports implementation of GBAS in Asia-Pacific (APAC) region as well as in Japan. ENRI worked as a technical advisor in implementation of the GBAS at HND. ENRI also supported the GBAS PoC project in Thailand in assessing ionospheric conditions, evaluating the performance of the GBAS system (Figure 2), and improving the system performance under severe ionospheric disturbance conditions. Researchers of ENRI are contributing to the ICAO APAC GBAS/SBAS ITF as core members.

Figure 2. GBAS performance evaluation tool.

5.4 ENRI conducts a research and develop program on advanced operations enabled by GBAS from April 2022 to March 2027. The objectives include improved surface operations in the low visibility condition, effective runway operations and reduced environmental load by using GBAS-specific function, and GBAS collision risk model (CRM) development for future procedure design with the following four research subjects. Further results will be reported in future meeting.

- The first is development of fundamental operational concepts for increased glide path (IGP) approaches and secondary runway aiming point (SRAP) operations utilizing GBAS. Potential benefits on noise abatement and reduction of fuel consumption are studied for major airports in Japan. As a new perspective, ENRI surveys beneficial cases in Japan focusing on IGS and SRAP to avoid the obstacles penetrating the obstacle assessment surfaces (OAS) in runways for which precision approach is not set. It is expected to enable precision approaches setting with the IGS and/or SRAP operations from technical considerations.

- The second is development of an operational concept and a testbed of pilot support tool for runway exit and taxi guidance using GBAS functions. Necessary functions and performance levels including interfaces of expected experimental devices are being investigated. Currently, the display software has been constructed and the hardware is being constructed for demonstration experiments using ENRI’s experimental aircraft.

- Concerning development of the CRM and improved obstacle assessment surface for GBAS, a smoothing method to calculate deviations from approach path obtained from the ADS-B data by using Kalman filter was developed. ENRI continues to collect observational data.

- The last subject is evaluation of reduced runway occupancy time with GAST D where ILS equivalent critical and sensitive areas is not required. ENRI examines improvements of runway throughput with GAST-D under low visibility conditions by comparing three cases in RJAA (Tokyo Narita), which are normal, ILS CAT-III and GLS CAT-III operations in fast time simulations.

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