International Civil Aviation Organization

THE SEVENTH MEETING OF THE ASIA/PACIFIC GBAS/SBAS IMPLEMENTATION TASK FORCE (GBAS/SBAS ITF/7)

(Bangkok, Thailand, 14- 16 May 2025)

Agenda Item 4: Updates on GBAS/SBAS system and States' implementation status

GBAS Status Update in Japan

(Presented by Japan)

SUMMARY

This paper presents an update to GBAS development in Japan.

Japan Civil Aviation Bureau (JCAB) has completed the trial operation of CAT-I GBAS at Tokyo International Airport (HND) from 2020 to 2024, and started the official CAT-I GBAS operation at HND from January 23, 2025.

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 contribution to the DFMC GBAS standardization and advanced operations with GBAS.

1. INTRODUCTION

1.1 Japan has developed an ionospheric threat model which defines anomalous ionospheric conditions in the low magnetic latitude region, and implemented an ionospheric field monitor (IFM) for GBAS at HND as an integrity monitor to address the ionospheric issues.

1.2 CAT-I GBAS trial operation has completed at Tokyo International Airport (HND) with limited domestic airlines from 2020 to 2024. Since the operational evaluation were successfully completed, official CAT-I GBAS operation was started from January 23, 2025.

1.3 Regarding GAST-D GBAS, Electronic Navigation Research Institute (ENRI) has conducted R&D with the GBAS prototype at Ishigaki airport (ISG) in Okinawa prefecture.

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

2. CAT-I GBAS

2.1 Result of Activities

2.1.1 In Japan, ENRI initiated R&D on GAST-C GBAS and installed the first prototype at Kansai International Airport (KIX) in 2011.

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

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

2.2 CAT-I GBAS operation at HND

2.2.1 JCAB contracted NEC Corporation a contract to manufacture and install the GBAS-16 (GAST-C GBAS) at HND in 2016.

2.2.2 Operational trial of CAT-I GBAS approaches started at HND in July 2020, with Japanese airlines ANA and JAL to experience the GLS approach. Operational trials were limited to midnight, with a total of 329 flights by October 2024, but good reviews were received from many pilots such that approach using the signal of GBAS is more stable than the one with ILS.

2.2.3 GBAS at HND also has gone through the certification process from the regulator and it successfully completed the certification process in October 2024.

2.2.4 The AIP for the official operation of GLS approach procedure was issued on the AIRAC dated on 28 November 2024, and the official operation was started on 23 January 2025, which was opened for all operators including foreign operators. CAT-I GBAS approach procedures was set for runways of 34R and 34L at HND. The route specified by the procedure is an overlay of the current ILS, and the applicable time for this procedure is from 14:00 to 21:00 UTC. (In Japan, this procedure is used from 23:00 to 06:00 JST.)

2.2.5 After the official operation was started, there were 49 GLS approaches from 23 January to 31 March, and no problems occurred at all. Availability during this period was 99.9964%. JCAB will closely monitor performance of the GBAS and comments from all operators.

2.2.6 Future expansion of operation to daytime and extension of the GLS approach procedure to other runways will be considered taking into account the increasing GLS equipment loading rate and the load on air traffic control operations.

3. CAT-III GBAS

3.1 In Japan, ENRI developed a GAST D GBAS experimental prototype for operational validation of GAST D SARPs in 2014. The experimental prototype included an ground experimental prototype subsystem and airborne experimental subsystem. The ground subsystem was installed at New Ishigaki Airport and used for GAST D flight experiments with the airborne subsystem

3.2 Japan contributed to ICAO activities on GAST D GBAS.

4. DFMC GBAS

4.1 ENRI has conducted R&D on DFMC GBAS since 2015.

4.2 DFMC GBAS will improve availability based on multi-constellation, and will mitigate threats of ionosphere based on dual frequencies.

4.3 The testbed of DFMC GBAS was developed and deployed at Ishigaki airport in 2019. Japan will contribute to ICAO activities on the development of DFMC GBAS SARPs.

5. **GBAS R&D STATUS IN JAPAN**

5.1 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 New Ishigaki Airport (24.4N, 124.3E, 19.8 Mag. Lat.) which consists of five DFMC reference stations installed in the airport field and a VDB transmitter (Figure 1). Two of the five ground reference stations are also equipped with an ionospheric scintillation receiver. 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 processes draft MT-23/50 generated by the testbed to support GAST E. The seven flight data collection campaigns were conducted since February 2020. The last flight campaign was conducted from 24 to 28 February 2025. Ground and airborne GNSS data were successfully collected including those under ionospheric severe ionospheric conditions. Next flight data collection campaign is planned in September 2025.

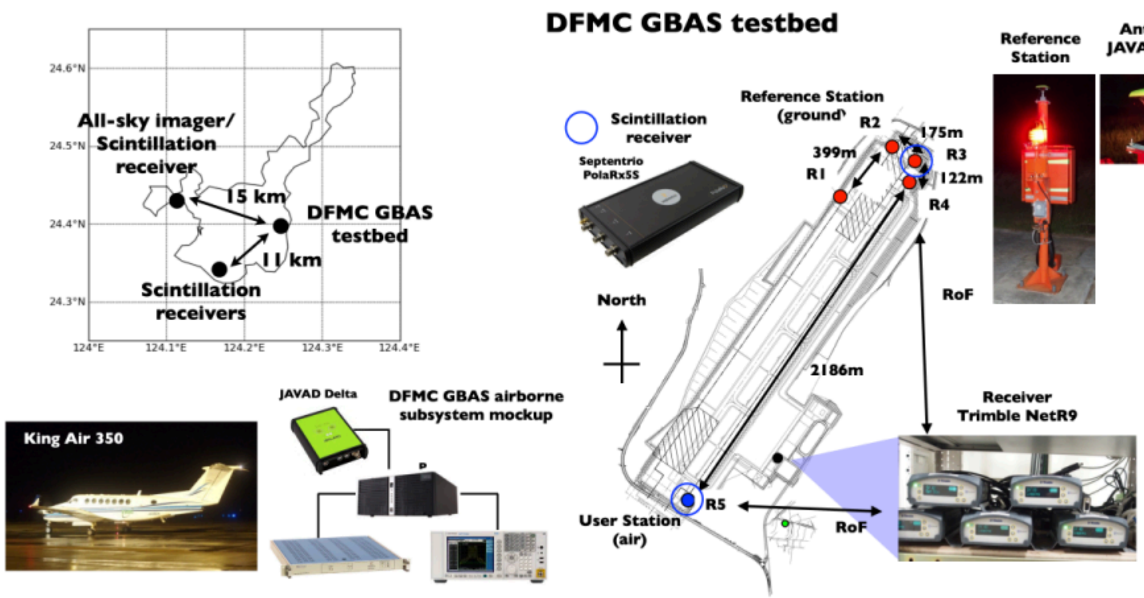

Figure 1. DFMC GBAS testbed at Ishigaki, Japan.

5.2 A new project for the period from April 2025 to March 2029 has started. DFMC GBAS SARPs development and validation is one of the main topics. It includes prototyping of a DFMC GBAS based on the DFMC GBAS testbed. Another research topic is on the DFMC GBAS extended function, i.e. carrier-phase-based applications utilizing MT-23. ENRI will continue to be committed to the development of DFMC GBAS through this project.

5.3 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 Ionosphere Gradient Mitigation (IGM) ad hoc group under ICAO Navigation Systems Panel (NSP) GBAS Working Group (GWG). 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.

5.4 ENRI supports implementation of GBAS in the world. ENRI worked as a technical advisor in implementation of the GBAS at HND. Researchers of ENRI are contributing to the ICAO APAC GBAS/SBAS ITF as core members. A researcher of ENRI is leading development of a GBAS Manual under the ICAO NSP GWG.

5.5 ENRI conducts research and develop program on advanced operations enabled by GBAS from April 2022 to March 2027. The objectives include improved airport 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.

- Development of fundamental operational concepts for increased glide path (IGP) approaches and secondary runway aiming point (SRAP) operations utilizing GBAS (Figure 3) for reduction of environmental load and improvement of runway throughputs.

    - Reduction of noise abatement: Noise reduction by setting approach paths away from the ground with IGP and SRAP is studied by taking into account noise sources related to speed control such as flaps, landing gear or engine rates, and evaluated with a full flight simulator. Noise reduction effects is evaluated using J-FRAIN * (Japan-FRamework for AIrcraft Noise simulation) in collaboration research with Kobayasi Institute of Physical Research.

    - Obstacle avoidance to set precision approaches: IGP and/or SRAP are considered to avoid obstacles that penetrate the obstacle assessment surfaces (OAS) for a precision approach under ordinary conditions. We conducted a comprehensive survey of airports in Japan and selected several runways for case studies. Experimental design of each precision approach path including Initial Approach Fix (IAF) and missed approach segment has been completed, and flight demonstrations by ENRI's experimental aircraft will be conducted.

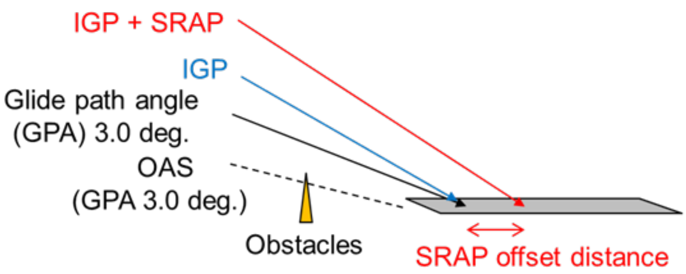

Figure 3. Concept of obstacle avoidance to set precision approaches with IGP and SRAP

- Development of an operational concept and a testbed of pilot support tool for runway exit and taxi guidance using GBAS functions.

    - Functions and performance levels including interfaces of expected experimental devices have been designed. An experimental software to display on a screen has been developed based on feedback from pilots and air traffic controllers. Initial demonstration experiments using ENRI's experimental aircraft are planned in 2025.

- CRM development and improved obstacle assessment surface for GBAS.

*J-FRAIN is component-wise regression sound source models for aircraft noise prediction developed by JAXA, University of Tokyo, Kobayashi Institute of Physical Research, and the Narita International Airport Promotion Foundation.

- 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 and to calculate them.

- Evaluation of reduced runway occupancy time with GAST D where ILS equivalent critical and sensitive areas is not required.

    - Improvements in runway throughput with GAST-D under low visibility conditions have been investigated by comparing three cases at RJAA (Tokyo Narita) for normal, ILS CAT-III and GLS CAT-III operations by fast time simulations using GRACE. Using actual traffic flow on the ground movement of airport surface during a low visibility condition, the improvement has been quantitatively evaluated with other operational conditions such as wake turbulence separations being considered.

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