INTERNATIONAL CIVIL AVIATION ORGANIZATION

TWENTY SEVENTH MEETING OF THE ASIA/PACIFIC AIR NAVIGATION PLANNING AND IMPLEMENTATION REGIONAL GROUP (APANPIRG/27)

Bangkok, Thailand, 5 to 8 September 2016

Agenda Item 3: **Performance Framework for Regional Air Navigation Planning and Implementation**

3.4: **CNS**

STATUS OF GNSS SYSTEM IMPLEMENTATION IN JAPAN

(Presented by Japan)

SUMMARY

This Information Paper provides current Global Navigation Satellite System (GNSS) status in Japan. Currently Japan Civil Aviation Bureau provides SBAS service using MTSAT Satellite Augmentation System (MSAS), and Receiver Autonomous Integrity Monitoring (RAIM) prediction information service for GNSS usage. This paper also introduces the future GNSS system implementation plan in Japan in order to promote GNSS usage in all flight phase.

Strategic Objectives:

A: ***Safety*** *– Enhance global civil aviation safety*

B: ***Air Navigation Capacity and Efficiency****—Increase the capacity and improve the efficiency of the global aviation system*

E***: Environmental Protection*** *— minimize the adverse environment effects of*

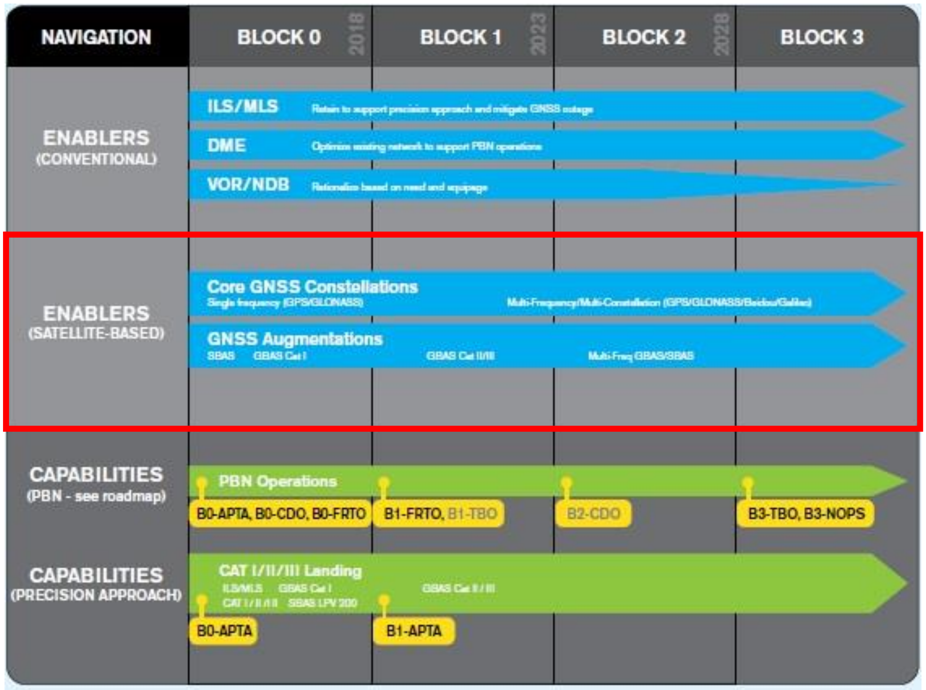
1. INTRODUCTION

1.1 Current Situation

1.1.1 ICAO Global Air Navigation Plan (GANP) Navigation Road Map shows that GNSS elements will be used for Performance-Based Navigation (PBN) operation as described in Fig.1.

1.1.2 In Japan, Satellite-based Augmentation System (SBAS) service using Multi-functional Transport Satellites (MTSAT) satellite has been provided since 2007 by MSAS for NPA level service in Japanese FIR (Fukuoka FIR). And RAIM prediction information service has also been provided in this FIR.

1.1.3 Regarding GBAS, Electronic Navigation Research Institute (ENRI) has been conducting GBAS research and development. ENRI conducted CAT-I GBAS demonstration experiment using the prototype in Kansai international airport, and also has been conducting GAST-D SARPs validation activity using GAST-D GBAS prototype in New Ishigaki Airport.



【Figure-1 GANP Navigation Road Map 】

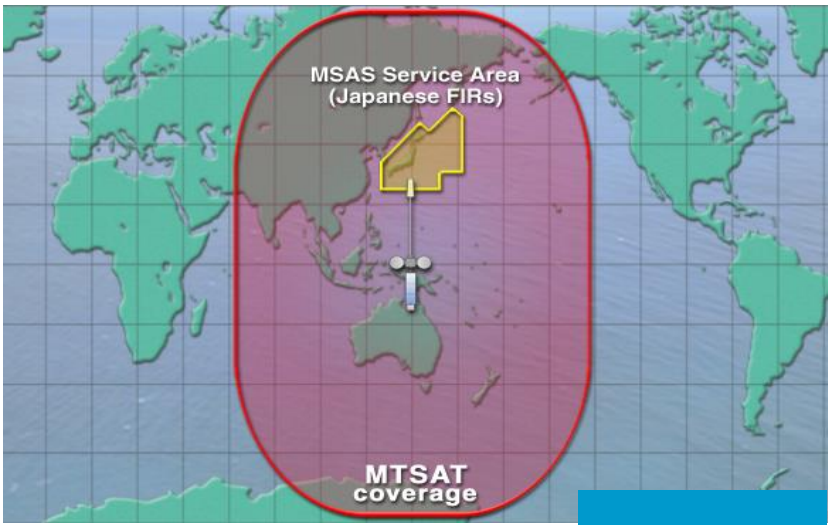
2. DISCUSSION

2.1 SBAS

2.1.1 MSAS current condition

2.1.1.1 MSAS is the Japanese SBAS system which provides SBAS signal (to user aircrafts) using MTSAT satellite.

2.1.1.2 Since 2008, MSAS had been providing two PRN signals (PRN129 and 137) using two MTSAT satellites (MTSAT-1R and MTSAT-2). However, as MTSAT-1R retired in December 2015, MSAS is operating by Dual PRN operation mode now. Two PRN signals are broadcasted by MTSAT-2 satellite in this mode. PR129 signal is uplinked from Kobe MCS (Master Control Station) and PR137 signal is uplinked from Hitachiota MCS.



【Figure-2 MSAS Foot print and Service area】

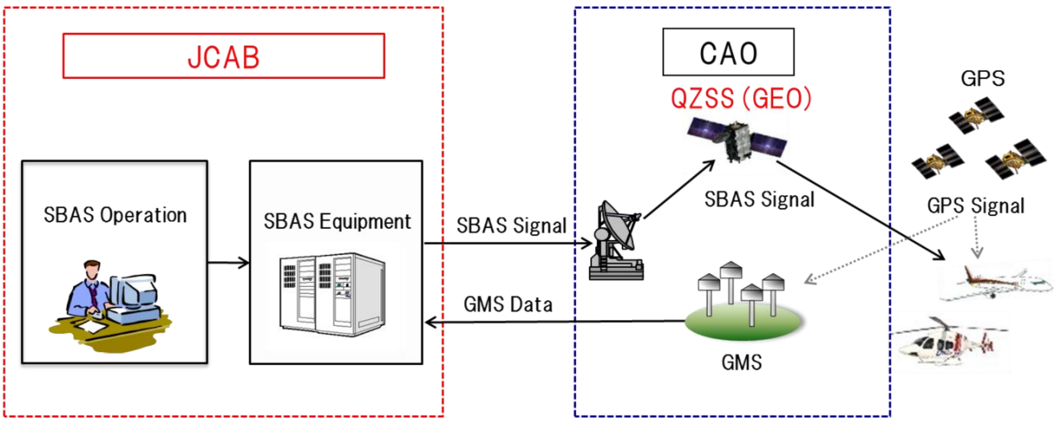
2.1.2 Next generation MSAS

2.1.2.1 Since the decommission of MTSAT-2 will be planned in 2020, the current MSAS service using MTSAT will be terminated. For this reason, JCAB (Japan civil aviation bureau) had studied next generation SBAS in Japan.

2.1.2.2 Before the termination of current MSAS service, Cabinet Office (CAO) of Japan will develop and deploy the Quasi-Zenith Satellite System (QZSS), and will start its operation in 2018 with one geostationary orbit satellite (GEO), and three geosynchronous inclined orbit satellites (IGSO).

2.1.2.3 Taking the QZSS development schedule into account, JCAB decided to develop the next stage SBAS of Japan using QZSS. The functional tests and performance evaluations with QZSS (GEO) satellite will be conducted from 2018, and the next generation MSAS will start its operation in 2020. Herewith the SBAS services in Japan can be continued without interruption.

2.1.2.4 The ground segment of next generation MSAS will consist of 13 GMSs in Japan, SBAS equipment installed at Hitachiota, and the three uplink stations set up at Miyakojima, Tanegashima and Hitachiota. Both GMSs and uplink stations will be included in QZSS configuration as described in Figure-3.



* GMS: Ground Monitoring Station

【Figure-3 Next Generation MSAS Configuration (After FY2020) 】

2.1.2.5 Japanese Government decided the QZSS configuration upgrade by increasing the number of satellites from four to seven by targeting year of 2023. Considering this configuration change, JCAB is investigating the following SBAS upgrade plan to the next stage.

- Implementation of SBAS system with redundant SBAS satellites
- Improvement of SBAS capability to include LP/LPV service

2.1.2.6 ICAO has started development of DFMC (Dual Frequency Multi Constellation) SBAS SARPs. This standardization will enable multiple uses of augmented GPS, GLONASS, Galileo and BeiDou for aviation, and will result in an improvement of GNSS performance. Based on this trend, QZSS will have a capability of the L5 signal transmission.

2.1.2.7 Demonstration experiment of DFMC SBAS is planned as R&D activities from 2018 by ENRI. Not only ICAO standard GNSS core constellations but also QZSS will be considered in this experiment.

2.1.2.8 Japan will also consider providing DFMC SBAS service by the future Japanese SBAS system using QZSS.

2.2 GBAS

2.2.1 Activities relating GBAS introduction

2.2.1.1 GBAS development in Japan has so far been conducted in ENRI. ENRI installed the GBAS test bed at Sendai airport in 2002, the GAST-C GBAS prototype at Kansai airport in 2010, and then GAST-D GBAS prototype in 2014 at New Ishigaki airport. The research and development activities have been conducted including verification of SARPs by the GAST-D prototype.

2.2.1.2 The GBAS implementation in Japan has been studied in the scheme of CARATS of Japan based on the direction of ICAO GANP, which is also shown in the Module of its ASBU. As a result, the decision of GBAS implementation to Japan was made based on the following conditions.

- GBAS has been implemented in many countries in the world.
- Airborne GBAS equipage rate has been increasing. Boeing promotes to make it as the standard equipment for their new type of airplanes and the optional selections of this equipment is available for all Airbus airplanes.
- According to the business case study on CARATS, it showed that GBAS implementation is sufficiently cost-effective.

  (RNP to GLS procedure is considered to be applied at the appropriate time after implementation of GBAS in Japan.)

2.2.2 GBAS installation

2.2.2.1 The airport for the first stage GBAS installation was studied considering the following requirements.

- Aircrafts with GBAS equipment must be applied to regular flights at the airport considered.

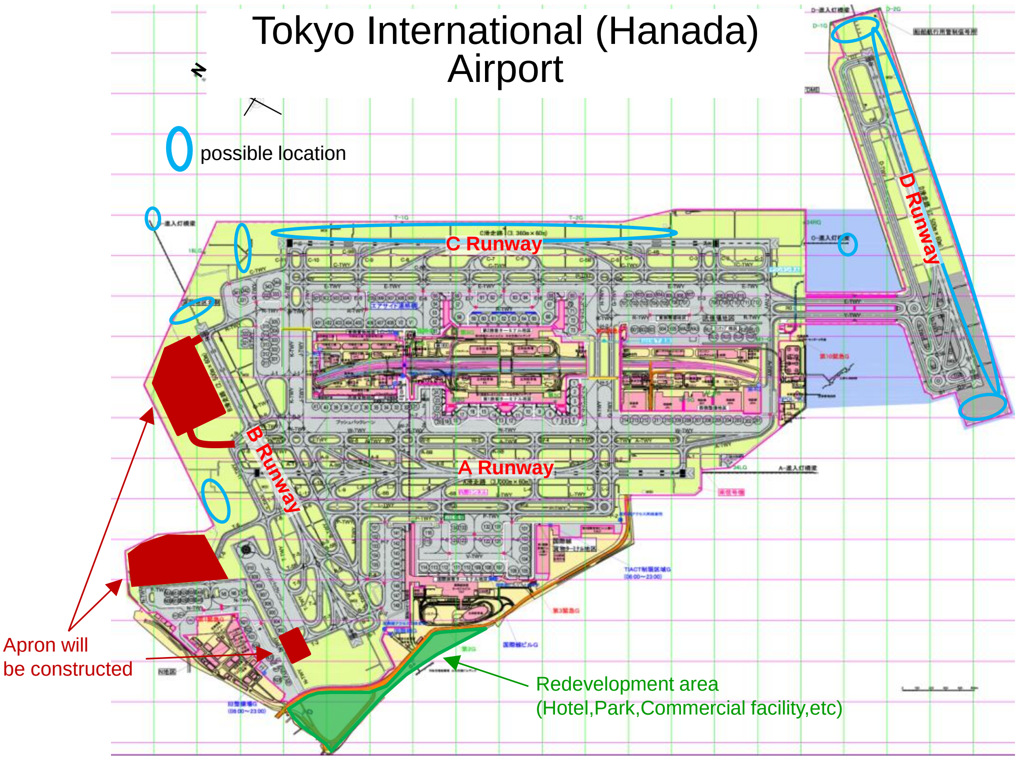
  (In Japan, only B-787 and B-747-8 type aircrafts have GBAS equipment aboard.)
- The airport considered must be capable of introducing GBAS based approach procedures for all runways.

  (Presently, available procedure is “ILS look alike” only.).
- Sufficient benefits are to be expected by GBAS installation.

2.2.2.2 As a result of the above study, JCAB decided to install GBAS in Tokyo International (Haneda) airport as the first GBAS system implemented airport in Japan. Haneda airport is the largest airport in Japan having the maximum traffic volume with four (4) runways.

2.2.2.3 GBAS system installed in Japan must be compatible with Japanese ionospheric conditions which is tougher than CONOUS model, and Japanese certification is required for this system. Japanese ionospheric threat model is defined under the cooperation by ENRI.

2.2.2.4 GBAS implementation in Haneda airport will start from this year and the installation is to be completed by the end of March 2019 (the end of Japanese Fiscal year of 2018). After the installation the evaluation operation will be conducted, then the start of CAT-I operation is planned before the end of March 2021 (the end of Japanese Fiscal year of 2020).



【Figure-4 GBAS installation study in Haneda airport】

2.2.3 GBAS deployment plan in Japan

2.2.3.1 JCAB promotes the study to implement CAT-I GBAS to major airports and CAT-III GBAS implementation to be done after the first GBAS installation in Haneda airport.

2.2.3.2 Regarding CAT-III GBAS implementation, it is considered necessary to assess the operational CAT-III GBAS development status and airborne GBAS equipage rate after the update of SARPs including CAT-III GBAS standards.

2.2.3.3 For the advancement of GBAS, Japan will continue to support the cooperative efforts to complete the development of CAT-II/III GBAS SARPs for amendment in 2018.

2.3 ABAS

2.3.1 Current RAIM prediction service

2.3.1.1 JCAB is providing RAIM prediction information in Fukuoka FIR via NOTAM and Web service.

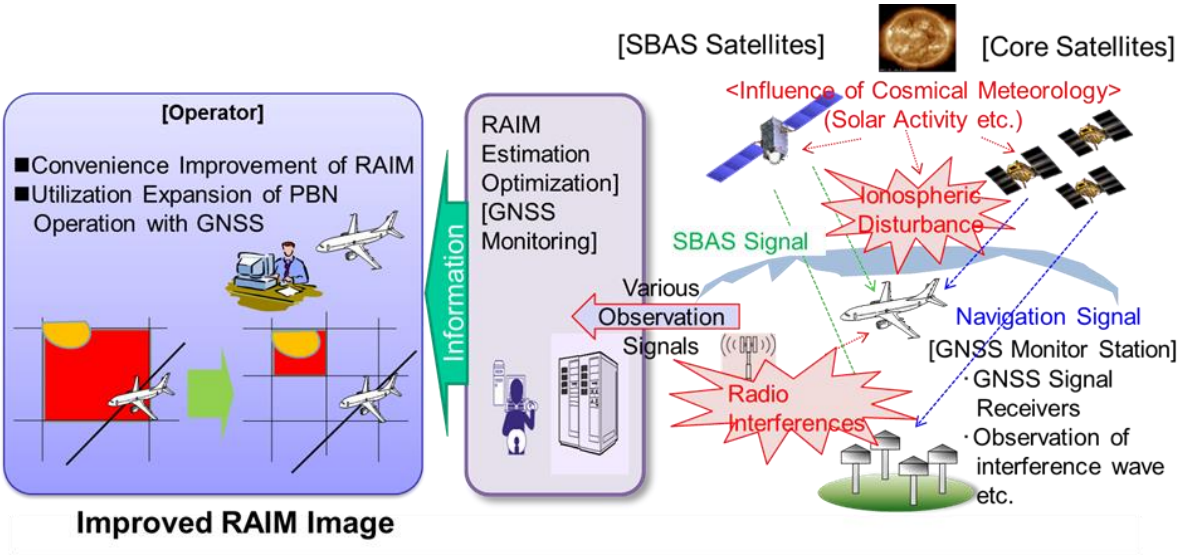
RAIM prediction service Web site: https://raim-japan.mlit.go.jp/

2.3.1.2 RAIM prediction information is provided to En-route and RNP procedures configured airports, and NOTAM will be provided when RAIM hole is predicted at such airports.

2.3.2 RAIM prediction optimization and GNSS signal monitoring

2.3.2.1 Since PBN will become main stream of aircraft operation, RAIM prediction optimization and user-friendliness of its prediction service are required by aircraft operators. Therefore, JCAB will conduct RAIM prediction in more detail and aim to improve the prediction service.

2.3.2.2 ICAO has been studying mitigation plan of GNSS vulnerability. In order to tackle GNSS vulnerability issues and support GNSS operations, JCAB decides to implement GNSS performance monitor system in the scheme of CARATS for GNSS performance monitoring and is studying for these system implementation.



【Figure-5 Improvement of RAIM and GNSS performance monitoring】

3. ACTION BY THE MEETING

3.1 The Meeting is invited to:

a) note the information contained in this paper; and

b) discuss any relevant matters as appropriate.

— END —