CNS SG/24 – **IP/15**
Agenda Item 5.5
30/11/20-04-12/20

International Civil Aviation Organization

Twenty Fourth Meeting of the Communications/ Navigation and Surveillance Sub-group (CNS SG/24) of APANPIRG

Web-conference, 30 November – 4 December 2020

Agenda Item 5: Navigation

5.5 Other navigation related issues

SBAS STATUS UPDATE IN JAPAN

(Presented by Japan)

SUMMARY

This paper provides information on the update of MSAS status and future plan.

1. INTRODUCTION

1.1 MSAS has started operation with MTSAT as a SBAS for Japan's FIR on September 27th 2007. As a part of GNSS implementation in Japan, MSAS (Michibiki Satellites Augumentation Service) using QZSS (Quasi-Zenith Satellite System) satellites has started operation from this April as Japanese SBAS. QZS3 (GEO) have been launched successfully on Aug 19 2017. A decision of MSAS LPV implementation was made on March 13 2018. The development QZS5 (IGSO), QZS6 (GEO) and QZS7 (GEO) was officially decided at Space Policy Committee of Japan in January 2019. MSAS LPV using three GEOs (QZS3, 6 and7) is expected to be operational in 2023.

2. DISCUSSION

2.1 MTSAT-2 was broadcasting two (2) PRN codes (Dual PRN mode: 129 and 137) as an MSAS GEO. MSAS is providing GPS Augmentation Information for RNAV, from En-route through NPA (RNP 0.3). A decision of LPV implementation was made on March 13 2018 based on the agreement with stakeholders.

2.2 Cabinet Office of Japan (CAO) has developed QZSS. QZSS has started services with four-satellite configuration consisting of one GEO and three QZOs from November 1st 2018. JCAB has started the development of the next stage SBAS of Japan and will conduct functional tests and performance evaluations with QZSS (GEO) satellite from 2018. MSAS transition from MTSAT to QZS-3 (GEO) has completed at the end of March 2020. PRN129 and PRN137 were transferred from MTSAT to QZS (GEO) satellites. L1 SBAS compatible signal will be transmitted using PRN187 from QZSS GEO in pre-operational testing period. QZSS seven (7) satellites configuration is expected in 2023 with three GEOs broadcasting L1 SBAS signal.

2.3 Currently two PRN codes (129 and 137) are assigned to MSAS. Additional PRN is necessary for three GEOs configuration in 2023 to perform a successful transition from the NPA service to the LPV service. JCAB is conducting a feasibility study of extending LPV service area to South-East Asia region outside of Japan's FIR.

	▲April2020		▲2023
	MTSAT MSAS	QZSS MSAS	
PRN 129	MTSAT-2	QZS3	QZS6
PRN 137	MTSAT-2	QZS3	QZS3
PRN XXX	-	-	QZS7

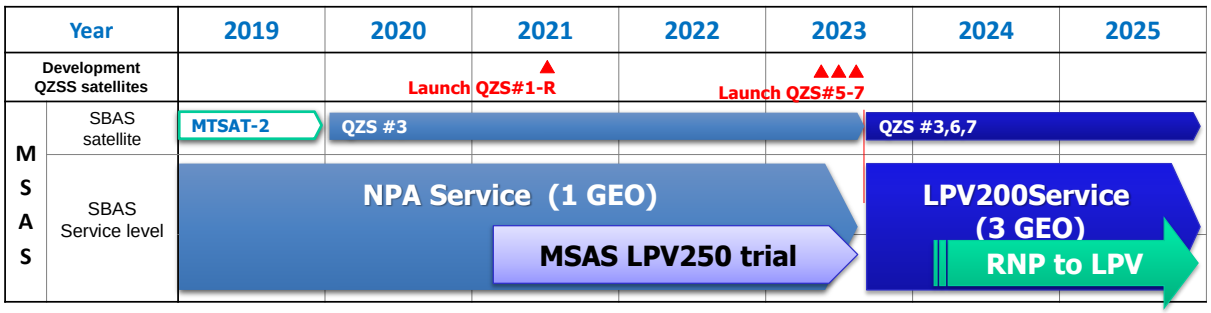
2.4

＜MSAS LPV full-scale operation＞ 2023～

As to MSAS LPV from 2023, for maximizing the policy effect of MSAS LPV, JCAB will start LPV operation at all airpots to designed IFR approach, excluding 2 military control airports, so the number of target airpot is 83. After full-scale operation of MSAS LPV in 2023, sequentially RNP to LPV will be designed.

＜<u>MSAS LPV250 trial operation</u>＞ 2021～

Using MSAS V2 which has been provided by only QZS-3, MSAS LPV250 approach will be introduced step by step from 2021 as MSAS LPV250 trial operation in advance of MSAS LPV full-scale operation. This trial operation will be expected to boost the proficiency of Airline pilots maneuver and the motivation for introducing SBAS LPV receiver in Airline. This MSAS LPV250 trial operation will be approved on the limited condition such as visual meteorological conditions (VMC). JCAB is under considering of the detail plan of MSAS LPV250 trial operation.



2.5 L5 augmentation signal with PRN196 (QZS2: IGSO) for DFMC SBAS validation became available on September 23 2017. Additional L5 augmentation signals are available with PRN197 (QZS3: GEO) and PRN200 (QZS4: IGSO). JCAB will start a process to change current L5 PRN (PRN197, PRN196 and PRN200) to SBAS PRN at a suitable moment. PRN assignment for non-GEO SBAS satellites is still pending in DFMC SBAS SARPs development. Along with the additional satellites development, QZS5 (IGSO), QZS6 (GEO) and QZS7 (GEO) will be installed with L5 signal supporting Manchester encoding.

2.6 MSAS configuration for each operational step is explained in the following table.

MSAS Version	**Topics**
MSAS V1: Initial Performance Phase (2007 ～ 2020)	- Operation with a MTSAT, 2 Master Control Station (MCS) and 6 Ground Monitor Stations (GMS) by 2020
MSAS V2: System Update Phase (2020 ～ 2023)	- Operational takeover to new GEO (QZS-3) - Full replacement of the SBAS ground system - 2 MCS, 13 GMS and 3 Uplink Station in domestic - Expected performance better than the current MSAS V1
MSAS V3: LPV Performance Phase (2023 ～)	- Vertical guidance: LPV operation by three QZSS GEOs - Need development of high performance IONO software for low latitude magnetic equatorial region based on the research outcome from ENRI
MSAS V4: DFMC Validation Phase (2017 ～)	- In support of ICAO SARPs validation activity, the initial target performance is LPV 200 - ENRI has started DFMC SBAS experiment in 2017 with QZS2 -QZS3 and QZS4 are available for DFMC SBAS validation -Support to GPS, Galileo, QZSS

2.7 Seven satellites configuration of QZSS will provide the constellation with additional two GEOs (i.e. QZS-6 and QZS-7). Therefore, a total of three GEOs will be capable of transmitting L1 SBAS signal in 2023. The longitude of the QZS-6 is 90.5degE. The center longitude of the QZS-7 is 190degE while its longitude will drift by some degrees due to a longer East West stationkeeping manuever cycle. The reduction of orbital maneuver frequency aims at an improvement of the service availability. The inclination of the QZS-7 is also greater than usual GEO in order to improve GEO orbit determination accuracy. The requirement of the GEO doppler requirement and L1 SBAS message effective ranges of satellite position and velocity will be satisfied even with this daviations from typical GEO orbit.

2.8 In addition to the L1 SBAS signal, all QZSS satellites but QZS-1 have the capability of broadcasting DFMC SBAS messages through the L5S signal. New satellites (QZS-5, 6, and 7) for the seven satellites configuration will provide L5S signal improvements such as Manchester Encoding and Q channel messages.

2.9 The L1 SBAS ranging will not be provided at the start of the service with the QZSS GEO. Evaluation of ranging accuracy from the view point of GEO orbit and clock accuracy as well as the ranging signal quality may make it possible to provide the ranging function in far future. Same possibility will be evaluated for DFMC SBAS L5 signal not only for GEOs but also for IGSOs.

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 matter as appropriate.

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