International Civil Aviation Organization

THE EIGHTH MEETING OF THE ASIA/PACIFIC GBAS/SBAS IMPLEMENTATION TASK FORCE (GBAS/SBAS ITF/8)

(Melbourne, Australia, 12-14 May 2026)

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

Potential use of SBAS in Singapore
(Presented by Singapore)

SUMMARY

Satellite-Based Augmentation Systems (SBAS) enhance the performance of Global Navigation Satellite Systems (GNSS) by improving positioning accuracy, integrity, continuity, and availability. This paper outlines the background of SBAS, examines potential aviation and maritime use-cases specific to Singapore's operational environment, and highlights considerations for adoption. The analysis positions SBAS as a foundational capability supporting future digitalisation, autonomy, and multi-modal operations.

1. INTRODUCTION

1.1 SBAS is a regional augmentation framework designed to enhance standard GNSS performance through the broadcast of correction data and integrity information via geostationary satellites. It typically relies on a network of ground reference stations, master control stations, and uplink facilities to monitor GNSS signals, estimate errors (e.g. satellite clock, orbit, and ionospheric effects), and transmit augmentation messages to users.

1.2 Globally, there are several operational and emerging SBAS implementations such as WAAS (United States), EGNOS (Europe), GAGAN (India), MSAS (Japan), BDSBAS (China), KASS (Republic of Korea), SouthPAN (Australia-New Zealand), ANGA (Africa) and SDCM (Russia). From an aviation perspective, SBAS primarily supports GNSS-based Instrument Flight Procedures (IFPs), including en-route, terminal, and approach operations. Recent developments in Dual-Frequency Multi-Constellation (DFMC) SBAS are expected to further enhance robustness and accuracy, particularly in regions with challenging ionospheric conditions.

1.3 Beyond aviation, SBAS offers a trusted positioning layer that can be leveraged by non-aviation users, provided service definitions and regulatory frameworks permit. For a dense, urbanised, and highly connected hub such as Singapore, SBAS can act as a critical enabler for cross-sector navigation and surveillance services.

2. Potential Use-Cases of SBAS in Singapore

2.1 Aviation Applications

2.1.1 In aviation, SBAS can significantly augment GNSS-based navigation services where Singapore provides Air Traffic Services. The primary use-case is the enhancement of GNSS-based IFPs, delivering improved accuracy and integrity across all phases of flight, including en-route, terminal, and approach/landing operations. This has the potential to support more flexible and

resilient procedure design, reduce dependency on conventional ground-based navigation aids, and improve operational availability under adverse conditions.

2.1.2 Within the airport environment, SBAS-enabled positioning can support surface movement operations by providing higher-confidence location data for aircraft and ground vehicles. This capability is particularly relevant for advanced airport operational concepts, including surface surveillance, management of ground assets, and the progressive introduction of autonomous or semi-autonomous systems. As air navigation services evolve towards increased digitalisation, SBAS may become a key positioning component supporting trajectory-based operations and enhanced situational awareness across the air-ground interface.

2.2 Maritime Applications

2.2.1 For maritime navigation, Singapore's port waters and approaches are among the busiest and most complex globally. The Maritime and Port Authority of Singapore (MPA) currently provide a Differential GPS (DGPS) service to enhance navigational safety, offering correction signals via medium-frequency radio beacons with high availability and metre-level accuracy.

2.2.2 SBAS, particularly DFMC SBAS, presents a potential complement or future alternative to traditional DGPS by delivering correction and integrity information via satellite broadcast. This offers several strategic advantages, including wider coverage, reduced reliance on terrestrial broadcast infrastructure, and improved scalability. For maritime users equipped with compatible receivers, SBAS could support safer navigation in port approaches, anchorage areas, and traffic separation schemes, while also enabling future concepts such as autonomous surface vessels and enhanced vessel traffic management systems. In a multi-domain context, the potential alignment of aviation-grade augmentation services with maritime needs may also enable shared infrastructure and common positioning services, subject to regulatory and service-design considerations.

3. Conclusion

3.1 SBAS represents a strategic enabler with transformative potential for Singapore's aviation and maritime sectors. By enhancing GNSS accuracy, integrity, and availability, SBAS can strengthen safety, operational resilience, and efficiency in increasingly complex operating environments. For aviation, it supports the evolution of GNSS-based procedures and advanced airport surface operations. For maritime, it offers a pathway towards more robust and future-ready positioning services beyond conventional DGPS.

4. ACTION REQUIRED BY THE MEETING

4.1 The meeting is invited to:

a) note the information contained in this paper; and
b) identify and share views on the use cases for SBAS within the aviation and non-aviation community.