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Author(s) / Submitter(s) Manuel Lopez (EUSPA), José Manuel Álvarez (ESSP), José Luis Martín (ESSP), Elisabet Lacarra (ESSP)

Retransmission of SBAS data through VDES

# Summary

G-1129 introduces the retransmission of SBAS corrections using MF Radio beacon and AIS. Section 4.3 introduces the future work to be done to provide SBAS corrections over other data channels such as VDES.

G1117 provides a VDES overview and considers as well the possibility to retransmit SBAS corrections with the advantage to use directly the RTCA format, which is independent of the location of the transmitter, (either terrestrial or satellite transmitter).

Therefore, taking advantage of the work done, this paper proposes a similar approach for the provision of SBAS data through the new VDES (VHF Data Exchange System) system/concept. To that purpose, particularities and challenges associated to this new system shall be considered by the Maritime actors with the aim to facilitate the synergies between SBAS and VDES and the benefits bringing by using both system together.

In this way, the following lines present the whole picture of SBAS augmentation service in Maritime, the analysis of the service provision aspects that have been widely discussed and evaluated to make possible the upcoming use of SBAS in Maritime SOLAS applications, the different mechanisms to facilitate the provision of SBAS data for Maritime users (SiS, retransmission through DGNSS) and ultimately the potential provision of SBAS data through VDES with a proposed strategy to enable it.

## Purpose of the document

The main objective of this document is to open the discussion for the identification of the strategic lines and relevant activities to be performed in coming years to enable the provision of SBAS data through VDES and prepare an update of G-1129 to include the corresponding guidance.

## Related documents

* IALA World Wide Radio Navigation Plan. December 2009. Revised December 2012
* IALA Guideline G1112 - Performance and Monitoring Of DGNSS Services in the Frequency Band 283.5-325KHz.
* IALA Guideline G1129 – The Retransmission of SBAS Corrections Using MF‐RadioBeacon and AIS. Edition 2.0 December 2017.
* IALA Guideline G1152 – SBAS Maritime Service. Edition 1.0 December 2019.
* IALA Guideline G1117 VHF Data Exchange System (VDES) Overview. Edition 3.0 December 2022
* IALA Recommendation (Normative) R1022 Provision of GNSS Augmentation Services for Maritime Navigation Applications. Edition 1.0 Junio 2021.
* IALA Recommendation (Informative) R0135 (R-135) The Future of DGNSS. Edition 2.1 September 2020

# Background

Global Navigation Satellite Systems (GNSS) is considered by IMO in [2] as the primary means of obtaining Position, Navigation and Timing (PNT) information at sea. GNSS augmentation is required to cope with the most stringent requirements defined for navigation in specific applications. In such a way, the traditional GNSS augmentation is based on the marine radiobeacon DGPS (Differential GPS) augmentation service, provided by maritime administrations, which improve accuracy while providing integrity for GPS [G-1112]. SBAS will complement the current DGNSS deployed infrastructure [G-1129, G-1152].

VDES (VHF Data Exchange) as the evolution of AIS is seen as the natural system to continue providing the differential GNSS corrections [G-1117].

# Discussion

## The different SBAS data transmission means

Regarding the provision of SBAS data to final users, this can be supported either by SBAS system per se and/or other augmentation solutions through two compatible mechanisms:

* Directly through SBAS Signal-in-Space (e.g. the forthcoming EGNOS Maritime Service).
* By retransmitting the SBAS data (corrections & integrity) via terrestrial augmentation systems as DGNSS stations (currently via IALA beacons and AIS stations and in the coming years through VDES). For this second mechanism, SBAS data can be provided to these stations either via SiS or through internet if available (for instance, EGNOS EDAS service).

In relation to the advantages of the provision of SBAS data through the SiS, for those locations within the SBAS service area the presence of an additional solution would mean:

* A free-of-charge alternative to DGNSS in those areas where the later service is not available temporarily (e.g. maintenance of the station or unavailability) or not deployed.
* Additional robustness of the GNSS augmentation for navigation purposes being therefore compatible either with DGNSS and other terrestrial-based augmentation systems.

In relation to the second mechanism proposed, different implementation models have been already defined for the retransmission of SBAS data, either using IALA beacons or AIS stations (in accordance with IALA G1129). The approach for this mechanism presents the following particularities:

* SBAS provides wide area corrections in RTCA format which have to be converted into local corrections in RTCM SC-104 format for the specific DGNSS station location.
* On the contrary to DGNSS, SBAS does not provide corrections to troposphere error. Thus, a model to mitigate the effect of this error should be implemented.

Regarding the advantages of this second mechanism, the mitigation of local effects affecting DGNSS stations (e.g. multipath) could be mitigated.

Complementary to the previous solutions presented, SBAS data could be also retransmitted using the new maritime radio communication system VDES (VHF Data Exchange System) and the new possibilities this system offers in terms of additional channels to retransmit the SBAS data, either the terrestrial-based (evolution of actual AIS) or the satellite-based (VDE-SAT). VDES is seen as an effective and efficient use of radio spectrum, building on the capabilities of AIS and addressing the increasing requirements for data through the system. Thus, VDES could allow the provision of SBAS data in the original RTCA format and so being non-dependent on the VDES transmitter location (and not requiring any conversion script/module like it is needed for IALA beacons and AIS stations). On top of that, SBAS corrections could be also retransmitted in VDES in RTCM format as differential corrections.

It is noted that VDES has both terrestrial and satellite components for exchange of digital data and will incorporate both AIS and Application Specific Messages (ASM).

In relation to the advantages introduced by VDES, it is worth of mentioning the potential extension of SBAS coverage to those areas where, even though are within the nominal service area of the SBAS system, the reception of SBAS SiS is not guaranteed as a consequence of reduced visibility of SBAS GEOs e.g. at high latitudes (above 70º N) [7].

## Next steps to enable the SBAS data in VDES

A New Work Team proposal on VDES has been already approved and constituted in IEC on August 2023. The IEC Technical Committee 80 will start working on the following standard: “*Maritime navigation and radiocommunication equipment and systems – VHF Data Exchange System (VDES) – Shipborne mobile station – Operational and performance requirements, methods of test and required test results*”.

As stated in the scope of the proposal:

* That document specifies requirements and methods of testing for any shipborne mobile stations that transmit on AIS, ASM and VDE channels as defined by ITU-R M.1371 and ITU-R M.2092.
* Equipment conforming to this document is suitable to be installed on-board ships that are engaged in international voyages and contains AIS Class-A functionality as described in IEC 61993-2.
* Equipment compliant with this document may connect to an external gateway using the standardised Presentation Interface to provide additional services.

Initially, this standard plans to be published by August 2026. In principle, this standard will be focused in the signal characteristics, not in the VDES message contents. It may be required another New Working Item Proposal to define the possible VDES message content, which could include the retransmit ion of SBAS data. The required process will be clearer in a later stage, when the work related to this IEC VDES standard has been started.

Complementary to the topics presented above, **the retransmission of SBAS data through VDES would imply the consecution of the following actions** (inter alia):

* Determination of implementation models which introduce SBAS data into VDES terrestrial stations architecture, either via SiS (SBAS-capable receiver) or via other means (e.g. through internet as EGNOS EDAS service).
* Definition of the VDES channel and message which will contain the SBAS data either for the terrestrial-based (AIS) and the satellite-based (VDES-SAT)
* Definition of the receiver equipment specification in order to correctly apply the SBAS corrections and associated monitoring alarms.

To accomplish with the previous actions, several mechanisms can be put in place to successfully achieve this purpose:

* To update G-1129 to include retransmission of SBAS using VDES.
* To propose a New Working Item Proposal (NWIP) in IEC to work on the technical standard related to define the VDES messages, in which it could be incorporated the container for SBAS messages.
* As for the case of AIS with IEC61993-2, a standard for the shipborne equipment of VDES would be required, covering operational and performance requirements, methods of test and required test results. For that a New Working Item Proposal (NWIP) in IEC should be approved. Once launched, it should be included the requirements to process SBAS messages and how to inject it to the SBAS receiver equipment. Depending on the scope of this standard, IEC61108-7 standard for SBAS L1 receiver equipment may be updated to include inputs from VDES.

# References

1. IMO International Convention for the Safety of Life at Sea (SOLAS), Chapter V (Safety of navigation), 1974 (as amended).
2. [IMO Resolution A.1046 (27) on the World Wide Radio Navigation System (WWRNS), November 2011.
3. IMO Resolution A.915(22) on the Revised Maritime Policy and Requirements for a future Global Navigation Satellite System (GNSS), January 2002.
4. IMO Maritime Safety Committee 98th session. Agenda item 23. MSC 98/23. 28 June 2017.
5. IMO E-Navigation Strategy Implementation Plan – Update 1. MSC.1/Circ. 1595. 25 May 2018.
6. Standard under development. IEC TC80 Maritime navigation and radiocommunication equipment and systems. Project IEC 61108-7 ED1 Global navigation satellite systems (GNSS) - Part 7: Satellite Based Augmentation System (SBAS) L1 - Receiver Equipment - Performance standards, methods of testing and required test results.
7. GNSS Augmentation using the VHF Data Exchange System (VDES). Jan Šafář, George Shaw & Alan Grant, General Lighthouse Authorities of the UK & Ireland; Hans Christian Haugli & Lars Løge Space Norway; Stig Erik Christiansen, Kongsberg Seatex; Nader Alagha, European Space Agency. AMNAS project (finance by ESA through ESA General Studies). 2018.
8. ENG17 paper- Upcoming IEC standard for SBAS L1 shipborne receivers

# Action requested of the Committee

The Committee and its members are requested to:

1. Note the information provided in this paper and;
2. Support an action for the preparation of an update to G-1129 to include a new chapter for the provision of SBAS over VDES

1. Input document number, to be assigned by the Committee Secretary [↑](#footnote-ref-1)
2. Leave open if uncertain [↑](#footnote-ref-2)