Input paper: [[1]](#footnote-2) ENG21-3.1.2.6

Input paper for the following Committee(s): check as appropriate Purpose of paper:

**□** ARM **X** ENG **□** PAP **X** Input

**□** DTEC **□** VTS **□** Information

Agenda item [[2]](#footnote-3) n.n

Technical Domain / Task Number 2 …………………………………

Author(s) / Submitter(s) José Luis Martín (ESSP), Elisabet Lacarra (ESSP), Guillermo Fernández (ESSP), José Manuel Álvarez (ESSP), Javier Esteban (ESSP).

Proposal of VDES ground and mobile stations upgrade to enable SBAS data retransmission. Update of G1129

# Summary

IALA G1117 [1] provides an overview of VDES (VHF Data Exchange System) giving additional information about the related technology, concepts, and the use cases supported by VDES. VDES is the next-generation maritime VHF data system that extends and protects AIS (Automatic Identification System) functionality while adding new VHF and satellite data links, wider channel options and new message types so vessels and shore systems can exchange far more information than AIS was designed to carry. Thus, this G1117 [1] guideline consider the option for VDES to retransmit SBAS (Satellite Based Augmentation System) corrections through this technology with the advantage to use directly the original RTCA format [12][13] used to provide SBAS data in Aviation (on the contrary to RTCM (OSR – Observation Space Representation) format, RTCA is independent of the location of the transmitter, either for a terrestrial or satellite transmitter).

IALA G1129 [2] sets out guidance for Marine Aids to Navigation (AtoN) service providers wishing to understand where SBAS information could be used to support the mariner and then how to employ such data for the retransmission of SBAS corrections in RTCM format using MF (Medium Frequency) Radio beacon and AIS. Complementary, this G1129 [2] guideline echoes about VDES as the evolution of AIS. Thus, the document emphasizes that the concepts defined for AIS to retransmit the SBAS corrections are applicable to VDES while also refers to the additional VDES data channels to enable this SBAS data retransmission in RTCA format.

This functionality for VDES to retransmit SBAS data have been thoroughly analysed in the input paper *“Analysis on the options for retransmission of SBAS data through VDES“* [7] presented for DTEC4 and ENG20 committees. Thus, this paper detailed the mechanisms proposed to enable the retransmission of SBAS data through VDES and specifically the definition of the recommended ASM, VDE-TER and VDE-SAT messages (as per ITU. Recommendation ITU-R M.2092-1 [8]) as well as the required parameters within these messages to identify the type of augmentation data/corrections (e.g. SBAS, RTK, PPP…) and the content and format of these data. This first technical material (extended with the suitable VDES Link IDs for the transmission of these messages) has been recently proposed as an update to the G1117 [1] for the review (and potential approval) in DTEC5 (within WG3).

As a continuation of the work introduced before, the next step implies the technical implementation of the mechanisms described above (and other complementary ones) on VDES system(s), and specifically to define how VDES ground and mobile stations should be upgraded such as:

* For VDES ground station, to receive, process and transmit SBAS data from SBAS SiS (Signal-in-Space) and/or other means (e.g. via internet), and
* For VDES mobile station, to receive and process the SBAS data from VDES ASM, VDE-TER and VDE-SAT messages (defined in G1117 [1] update proposed) enabling as well:
  + The (external to VDES) GNSS receiver on board (acting as the primary EPFS – Electronic Positioning Fixing System) applies SBAS corrections to enhance the accuracy (and integrity) of vessel navigation and positioning.
  + The internal to VDES GNSS receiver (acting as back-up of the primary EPFS) applies SBAS corrections also to provide an accurate vessel positioning report through VDES.

## Purpose of the document

The main objective of this input paper is to present the scope of the pretended update of G1129 [2] to perform, identifying two main lines of work (Task A and Task B) to cover the description of technical implementations within VDES ground and mobile stations, and enabling the seamless retransmission of SBAS corrections since VDES ground station receives the data from the original SBAS source (SiS and/or terrestrial means as streams over internet) till VDES mobile equipment processes this information to improve the accuracy of vessel positioning and navigation.

## Related documents

* IALA Guideline G1129 – The Retransmission of SBAS Corrections Using MF‐Radio Beacon 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. Update proposed in DTEC5 to Edition 3.0 (December 2022).
* IALA Recommendation (Informative) R0135 (R-135) The Future of DGNSS. Edition 2.1 September 2020
* ENG17-3.1.2.8 “Retransmission of SBAS data through VDES” input paper.
* DTEC4 -6.2.3.6 (or ENG20-3.1.2.4) Analysis on the options for retransmission of SBAS data through VDES

# Background

Global Navigation Satellite Systems (GNSS) is considered by IMO in [1] as the primary means of obtaining Position, Navigation and Timing (PNT) information at sea. GNSS alone does not meet the most stringent requirements for navigation requiring in this case the use of GNSS augmentation data. In such a way, the traditional GNSS augmentation is based on the marine radio beacon DGPS (Differential GPS) augmentation service, provided by maritime administrations, which improve accuracy while providing integrity for GPS (IALA G1112 [4]). As a complementary solution to DGPS (IALA G1129 [2] and G1152 [3]), SBAS (Satellite Based Augmentation System) provides also increased accuracy and integrity to the PNT solution computed by a compatible receiver (as per IEC 61108-7 [9]), complementing the current Differential GNSS (DGNSS) services while providing additional capabilities such as the extended regional coverage area (for instance, EGNOS in Maritimes as per [10]). Additionally, SBAS could be also used as a source of GNSS corrections and integrity information to be retransmitted over the following Maritime Servicer Provider’s AtoN:

* DGNSS stations (maritime radio beacons)
* AIS (Automatic Identification System) stations using the AIS Message#17
* VDES (VHF Data Exchange) data channels

About the first two options, DGNSS and AIS stations, currently IALA G1129 [2] describes in detail the concept to enable the provision of SBAS L1 corrections and integrity information through them as well as it proposes the technical architectures to do so.

For VDES, being the evolution of AIS to overcome the main limitations this later presents, is seen as another option to continue providing SBAS corrections and integrity (IALA G1117 [1] and G1129 [2]), specially due to the increase of data bandwidth which characterizes VDES in comparison to AIS..

For VDES, the G1117 update [1] proposed in DTEC5 already details the messages and channels (ASM, VDE-TER and VDE-SAT) to facilitate the SBAS data retransmission. For these new messages, it is proposed VDES will retransmit current SBAS L1 messages as well as the forthcoming SBAS L5 messages (DFMC – Dual Frequency Multi-Constellation).

# Discussion

## Tasks proposed to upgrade VDES ground and mobile stations. Update of G1129.

Two main lines of work are proposed to upgrade VDES ground and mobile stations to enable the retransmission of SBAS data over VDES:

* **Task A. Proposal of VDES ground station upgrade.**
  + Scope. Identification and description of required elements to:
    - Facilitate the reception of SBAS data from SiS and/or terrestrial data streams
    - Provision of this data to other VDES functional elements (notably VDES transceiver) to build the related VDES messages (the ones defined in the recent G1117 [1] update) for its subsequent transmission through VDES corresponding channels (ASM, VDE-TER, VDE-SAT). This is internally facilitated through the Presentation Interface.
    - New Presentation Interface ad-hoc message should be defined to make possible VDES transceiver is able to get the SBAS data.
  + Assumption(s).
    - In case it is intended to receive the SBAS data through SBAS SiS, a GNSS antenna(s) compatible with L1 and L5 signals as well as a GNSS DFMC SBAS receiver (L1 and L5) shall be implemented within the VDES ground station.
    - SBAS could be received by the ground station internal GNSS receiver via SBAS SiS (through GNSS antennas deployed) or terrestrial means (if VDES station presents an internet connection and SBAS).
    - SBAS data received is internally provided to VDES transceiver through the Presentation Interface.
* **Task B. Proposal of VDES mobile station upgrade.**
  + Scope: Identification and description of the required elements to:
    - Facilitate the SBAS data received by VDES mobile station (through VDES channels/message) is forwarded to GNSS receiver on board (acting as the primary EPFS) through the Presentation Interface.
    - Propose the logic of SBAS corrections consumption by the GNSS receiver on board (acting as the primary EPFS) and the internal GNSS receiver implemented within VDES equipment.
    - New Presentation Interface ad-hoc message should be defined to make possible the GNSS receiver on board (acting as the primary EPFS) is able to get the SBAS data.
  + Assumption(s).
    - A GNSS antenna(s) compatible with L1 and L5 signals as well as a GNSS DFMC SBAS (L1 and L5) receiver shall be deployed on board for vessel navigation and positioning.
    - A GNSS DFMC SBAS receiver (L1 and L5) shall implemented within the VDES mobile station.

These two lines of work and the outcomes resulted will be then included as an update of IALA G1129 [2] once the technical content is mature and agreed at IALA.

In regards the proposal upgrade for VDES ground and mobile stations, it is understood the technical implementation would not mean a significant complexity or additional cost to the current architectures considered by the industry or and in the related standards.

## Benefits of using VDES to retransmit SBAS data

Regarding the main benefits foreseen of using VDES for retransmitting SBAS augmentation it is considered:

* Navigation solution using SBAS is reliable, resulting in reduced navigation errors with respect to GNSS standalone. Thus, use of VDES to retransmit SBAS data as an alternative means to provide GNSS augmentation will increase the robustness and safety of PNT.
* Retransmission of SBAS data is so relevant in case of SBAS satellites outages (but still SBAS ground segment is working properly and generating augmentation data), obscuration (SBAS satellite signal blocked by natural or man-made obstacles) or reduced visibility of SBAS GEO satellites at high latitudes (above 70º N). Notably, SIS obstruction is particularly likely in canyon areas or near cliffs.
* VDES will enable greater bandwidth compared to traditional AIS (Automatic Identification System). It expands data transmission capacity, allowing for higher data rates, improved communication efficiency, and enhanced maritime safety and navigation services. Thus, it could be used to include the provision of SBAS augmentation data for maritime community.

## Way forward proposed

* Review and consolidation of the upgrade proposed in Task A and Task B.
* Encourage the involvement of IALA experts to support the VDES stations upgrade and so the work proposed in Task A and Task B. It is assumed intersessional work could be required between committees (plan to be defined and agreed among collaborators)
* Liaison among DTEC and ENG committees would be needed to work on this topic in both committees (if needed).
* Discuss on the need of additional workstreams to work on and follow-up, mainly with standardization bodies (IEC, ITU, RTMC…), to complement the technical description of the retransmission means. The required liaison process could be put in place if needed.

# References

1. IALA Guideline G1117 VHF Data Exchange System (VDES) Overview. Update proposed in DTEC5 to Edition 3.0 (December 2022).
2. IALA Guideline G1129 The retransmission of SBAS corrections using MF-radio beacon and AIS. Edition 2.0. June 2022
3. IALA Guideline G1152 SBAS Maritime Service. Edition 1.0 December 2019.
4. IALA G1112 Performance and Monitoring of DGNSS services in the frequency band 283.5 – 325 KHz
5. IMO Resolution A.1046(27) World Wide Radio Navigation System
6. IMO Resolution A.915(22) Revised Maritime Policy and Requirements for a future GNSS
7. DTEC4 -6.2.3.6/ ENG20-3.1.2.4 Analysis on the options for retransmission of SBAS data through VDES
8. ITU. Recommendation ITU-R M.2092-1 Technical characteristics for a VHF data exchange system in the VHF maritime mobile band. Ed Sept 2024 as a draft.
9. IEC 61108-7 SBAS L1 -Receiver equipment – Performance standards, methods of testing and required test results
10. EGNOS Maritime service status and status (ppt), Silvia Porfili, EUSPA. EGNOS Workshop 2024 (Dublin, 13/03/2024).
11. EGNOS Safety of Life assisted service for Maritime users (ESMAS). Service Definition Document (SDD). Issue 1.0. March 2024
12. DO-229 Minimum Operational Performance Standard (MOPS) for GPS/WAAS airborne equipment
13. ED-259A/RTCA DO-401 Minimum Operational Performance Standard (MOPS) for DFMC SBAS airborne equipment

# Action requested of the Committee

The Committee is requested to: (Body text)

1. Review the input paper and the proposed activities
2. To agree on the way-forward proposed in section 3.3

1. Input document number, to be assigned by the Committee Secretary [↑](#footnote-ref-2)
2. Leave open if uncertain [↑](#footnote-ref-3)