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Agenda item 6.2

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

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Transmission of GNSS augmentation data over VDES

# Summary

VDES provides a standardized communication channel with sufficient bandwidth to support the transmission of GNSS augmentation data for multiple GNSS constellations, improving high-accuracy navigation in confined maritime environments.

## Purpose of the document

This submission proposes the inclusion of a standardized message format within IALA Guideline G1117 for the transmission of RTCM-compatible GNSS augmentation data over VDES. By defining such a message, the maritime industry can leverage VDES for high-accuracy navigation and positioning, improving safety and efficiency in complex navigational environments.

# Background

GNSS augmentation enhances the accuracy, reliability, and integrity of satellite navigation, which is crucial for the maritime industry. By providing real-time corrections and error mitigation, GNSS augmentation enables safer and more efficient operations at sea, in ports, and inland waterways. This improved positioning capability supports various maritime applications, including navigation, port operations, and environmental monitoring.

Key benefits include:

* Enhanced Safety & Collision Avoidance – Precise positioning and reporting reduces the risk of vessel collisions, especially in confined environments.
* Efficient Port & Harbor Operations – Accurate docking and berthing improve port efficiency and reduce delays.
* Support for Autonomous & Smart Shipping – High-precision GNSS enables automated navigation systems and aids in the development of autonomous vessels.

VDES, the next generation of AIS, is a standardized maritime data exchange system supporting terrestrial and satellite communication, and it is ideally suited to support GNSS augmentation applications.

# Discussion

The RTCM messaging format to transfer different forms of GNSS augmentation data types are defined in [1]. This data can be transferred over various interfaces, commonly over IP (NTRIP) or propriety radio links. Multiple GNSS augmentation applications can be addressed, including PPP and RTK correction data.

RTK-based navigation relies on high-precision GNSS corrections provided by a local reference station. Traditionally, the transmission of RTK correction data to vessels has been achieved using proprietary low-bandwidth radio links, which are increasingly inadequate as the number of operational GNSS constellations has grown. As a result, many existing systems are constrained to supporting only a single GNSS constellation, limiting positioning accuracy and robustness.

Recent demonstrations by S3C and CML have confirmed that VDES offers sufficient bandwidth to transmit RTK correction data from multiple GNSS constellations within a single slot. This was done using a VDES Base Station transmitting in one Announcement Signalling Channel (ASC) slot every second using less than 3% channel resources.

This capability presents an opportunity to enhance maritime navigation operations by providing an open, standardized means of transmitting RTK correction data over VDES.

The integration of RTCM-compatible GNSS augmentation data transmission within VDES could offer significant benefits to maritime navigation, particularly in localized high-accuracy applications.

Standardizing a VDE Protocol Format message for this purpose within [2] would:

* Facilitate interoperability between different manufacturers and systems;
* Allow multiple GNSS constellations to be used in parallel, improving accuracy and redundancy;
* Mitigate the need for licensed radio channels, as internationally allocated VDES channels can be used efficiently, without degrading other VDES services.

## Further considerations

In addition to defining an RTCM data transmission format, the committee is invited to consider how VDES can further support high-accuracy navigation and positioning. Potential areas of interest include:

* Authentication of GNSS augmentation data to ensure data integrity to enhance safety and security;
* As the resolution of AIS position reports are limited, to consider the addition of high-resolution position reports and supplementary metadata from onboard systems to enhance situational awareness.

# References

1. RTCM Standard 10403.4, Differential GNSS Services – Version 3 with Amendment 1, November 2024
2. IALA Guideline G1117 VHF Data Exchange System (VDES) Overview – Edition 3.0, December 2022

# Action requested of the Committee

The committee is invited to:

1. Consider the inclusion of a standardized VDE Protocol Format message in [2] for the transmission of RTCM-compatible GNSS augmentation data as defined in [1] over VDES. See proposed amendments to [2] in APPENDIX 1.
2. Review how VDES can be further utilized to enhance high-accuracy maritime navigation, particularly in terms of data authentication and enriched vessel position reporting.
3. Proposed changes to G1117 VHF Data Exchange System (VDES) Overview

| **Comment Number:**  **Name-#** | **Change Log ID #** | **Annex / Section** | **Section, Table, Figure** | **Type of change** | **Reason for the change** | **Proposed change to G1117** |
| --- | --- | --- | --- | --- | --- | --- |
| *CML-1* | ## | Section 3.4 |  | Addition | Update Description of Broadcasting GNSS Augmentation data scenario | See below. |
| *CML-2* | ## | Section 6 |  | Addition | Add reference to RTCM Standard 10403.4 | See below. |
| *CML-3* | ## | Annex B.4 |  | Addition | Define VPFI message to transfer RTCM GNSS augmentation data over VDES | See below |

*CML-1:*

### **3.4.2 Scenario - Broadcasting GNSS augmentation data**

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When spoofing or jamming attacks are made on GNSS signal, GNSS augmentation systems provide additional data to users of GNSS equipment to improve accuracy, reliability and availability. Integrity and correction data are generated based on measurements from the ground network and relayed from VDES shore stations or VDES satellites to GNSS users. VDES provides means to communicate GNSS augmentation data by satellite (SBAS), and terrestrial (similar to AIS Message 17).

High-precision navigation operations utilising Real-Time Kinematic (RTK) correction data can be supported by a surveyed reference station providing RTK correction data to be transmitted by a VDES shore station as detailed in Annex B.4.1. This functionality is currently provided by low bandwidth legacy radio equipment, but it is often not capable of providing all the correction data from the large amount of operational GNSS satellites. Using VDE-TER, a shore station can transmit local RTK correction data from multiple GNSS constellations within a single slot every second. This provides redundancy from multiple constellations and can support high precision navigation operations in ports, locks and canals.

*CML-2:*

[39] IALA. Guideline G1158 on VDES R-Mode. Ed.1.0, December 2020.

[40] RTCM Standard 10403.4, Differential GNSS Services – Version 3 with Amendment 1, November 01, 2024

*CML-3:*

B.4. VPFI 6: GNSS Augmentation messages

B.4.1 RTCM GNSS Augmentation Message

This VDE Protocol Format may be used to transmit GNSS augmentation data as specified in [40] over VDE-TER.

Table 19 RTCM GNSS augmentation data over VDE-TER

|  |  |  |
| --- | --- | --- |
| Parameter | Number of bits | Description |
| VPFI | 16 | 6 |
| Message ID | 16 | 0 |
| RTCM differential correction data | Variable size | Data is packed as per the transport layer definition in [40]. |
| Total number of bits | Variable size |  |