Input paper: [[1]](#footnote-1) ENG13-3.1.3.11

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

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

**□** ENAV **□** VTS **X** Information

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

Technical Domain / Task Number 2 3.2

Author(s) / Submitter(s) Ginés Moreno (GMV), Marcos López (GMV), Jorge Martínez (GMV), Philipp Scheidemann (GSA), Manuel López (GSA).

Use of Galileo Timing to support implementation of R-MODE:

Pilot Project

# Summary

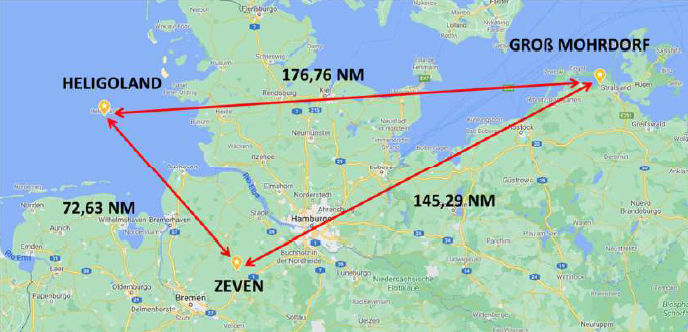
GNSS is already widely used in different fields for timing and synchronization purposes, including critical infrastructures in which a freely, stable and accessible timing source is required.

R-mode (Ranging mode) technology is being developed in the frame of maritime community as a terrestrial backup positioning system to GNSS. It is possible to calculate user receiver position in relation to fixed-shore and synchronized radio transmitters. Up to date, the most relevant initiatives for R-mode deployment make assumptions regarding infrastructure synchronization; in particular ACCSEAS project assumed perfect synchronisation between nodes. The most recent project, R-mode Baltic, is currently implementing GPS-based timing solutions, but the next steps of the project may consider other technologies (atomic clocks, Galileo timing, eLoran). At this point, Galileo represents an interesting and cost-effective timing solution which could be considered in the frame of R-mode.

The objective of this upcoming activity is to analyse operationally the suitability of Galileo Timing for R-Mode considering the analysis of Galileo capabilities for timing purposes in R-Mode analysed in GSALOT3TRANSSC3 project. To do so, in the frame of this project the consortium will implement a Pilot project to validate the user requirements of Galileo Timing in R-Mode. The methodology proposed is presented below:

* Step 1: Prepare and implement a Pilot project in cooperation with interested authorities.
* Step 2: Assess the suitability of performances and identification of user requirements;
* Step 3: Deliver a description of the suitable infrastructure and practical guidelines to implement Galileo timing in R-Mode.

The pilot project will focus on the Galileo OS Timing Determination capability as long as it is the only available Galileo timing option to date. This activity has just started on 15th January 2021 and the plan is to perform the pilot project and outputs a long this year 2021. Installation of Galileo timing capabilities is expected to be performed at three R-Mode identified stations. An R-Mode receiver already installed within the coverage area of R-Mode transmitting sites is planned to be part of the pilot system. Stations and receiver at “user level” are key modules of the performance analysis of Galileo timing test campaign.



1. . Potential Galileo Timing pilot for R-Mode configuration

This activity will be performed in close coordination with R-Mode Baltic project key partners (specifically WSV and DLR), who have expressed their interests in supporting this pilot.

Galileo timing is a promising technology to be considered as a cost-effective alternative to the use of atomic clocks for R-mode infrastructure synchronization. This aspect shall be confirmed by the pilot outcomes. Let us remark that the nature of R-mode is to be a backup solution for GNSS motivated by the vulnerabilities and assumptions highlighted in IALA R-129 [5]. These interferences are expected to be local (e.g. spoofing) affecting maybe the GNSS receiver of some vessels, but not affecting all R-MODE signals synchronised in land. GNSS-based timing solution as input for R-mode, can be also seen as another source of synchronisation to make R-MODE resilient to failures or to detect spoofing attacks close to stations.

For further information about the project please contact Manuel López Martínez (GSA, <Manuel.LOPEZMARTINEZ@gsa.europa.eu>).

## Purpose of the document

The objective of this paper is to make IALA members aware about the upcoming activity to analyse the suitability of Galileo Timing for R-Mode considering the analysis of Galileo capabilities for timing purposes in R-Mode analysed in GSALOT3TRANSSC3 project.

# References

1. Maritime Safety Committee, MSC 85/26, Annex 20. Strategy for the development and implementation of e-navigation, 19 December 2008
2. Multisystem - Radionavigation Receiver Performance Standard MSC.401(95), 8 June 2015
3. Worldwide Radionavigation System. IMO Res. A.1046 (27) , 30 November 2011
4. “Guidelines for shipborne position, navigation and timing (PNT) data processing” (MSC.1/circ.1575), 16 June 2017
5. IALA Recommendation GNSS vulnerability and mitigation measures R-129, 07 December 2012
6. Guidelines for shipborne position, navigation and timing (PNT) data processing. MSC.1/Circ.1575, 16 June 2017
7. Galileo Open Service – Service Definition Document (OS-SDD) Issue 1.1, May 2019
8. “Time and Synchronization User Requirements” GSA-MKD-TS-URED-233690 v1.0, 08/09/2017
9. “GSA User Technology Report”, Issue 2.0, 2018
10. “GSA Market Report” Issue 5, 2017
11. ACCSEAS Final Report Review of ACCSEAS Solutions through tests and demonstrations, 13/05/2015
12. Feasibility Study of R-Mode using AIS Transmissions. Investigation of possible methods to implement a precise GNSS independent timing signal for AIS transmissions, 29/08/2014
13. Feasibility Study of R-Mode using MF DGPS Transmissions Report 11/03/2014
14. Hoppe, M & Johnson, Gregory & Swaszek, Peter & Alberding, J & Oltmann, J.-H. (2014). Feasibility of DGNSS R-mode as a Component of the Multi-Source Positioning Service, 04/2014
15. Hoppe, M & Strenge, Rainer. Developments in radio navigation systems. PIANC-World Congress Panama City, Panama 2018, 05/2018
16. R-Mode Baltic - Baseline and Priorities, 11/03/2019
17. GSALOT3TRANS-SC3 project. D3.1 – Report on use of Galileo Timing to support implementation of R-MODE, 09/08/2019

# Action requested to the Committee

The Committee is requested to:

1. Take into account this input paper and the study described to support the work of IALA Guidelines for both R-MODE and Timing.
2. ........
3. Appendix heading 1
   1. Appendix heading 2
      1. Appendix heading 3

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