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**Input paper for the following Committee(s):** **Purpose of paper:**

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

**Technical domain/ Task number** 2 …………………………………

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Galileo Timing for R-Mode Pilot Project[[3]](#footnote-3)

# 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.

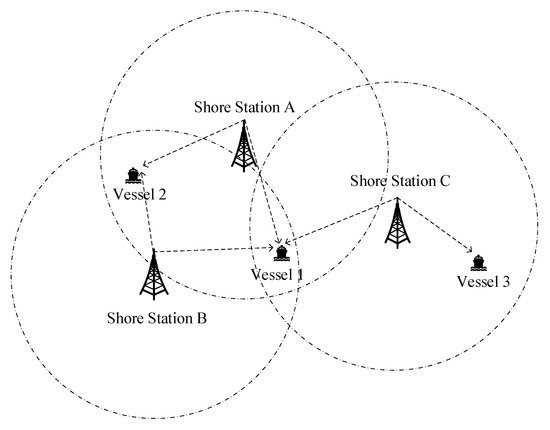
Galileo is Europe’s civilian Global Navigation Satellite System (GNSS). The system was born in the 1990s, in the pursuit of Europe’s sovereignty and independence from non-civilian American GPS and Russian GLONASS constellations, and started its initial services on December 15th, 2016. Galileo provides greater precision than other available system, has higher availability, increases GNSS coverage by being interoperable with other systems, provides emergency-response services, etc.

Figure 1‑1 R-Mode scheme

R-mode (Ranging mode) technology is being developed in the frame of maritime community as a terrestrial backup positioning system for maritime and inland waterways navigation in case any of GNSS vulnerabilities takes place as jamming and spoofing. R-mode allows calculating user receiver position in relation to fixed-shore and synchronized radio transmitters.

1. R-Mode scheme

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 PRS, eLoran).

The addition of Galileo satellites contributes to improve the accuracy performance of GNSS users, including the time and synchronization community. Galileo satellites may also improve integrity and ensure availability of the timing service in case other GNSS constellation experiences outages. For this reason, Galileo is a promising technology to be considered as a cost-effective alternative to the use of atomic clocks for R-mode infrastructure synchronization as it was already analysed in GSALOT3TRANS-SC3 project. Let us remark that the nature of R-mode is to be a backup solution for local GNSS vulnerabilities aforementioned. Despite GNSS is still needed for R-mode synchronisation, the limited range of intentional attacks makes difficult that a single vulnerability affects a vessel and a significant number of R-Mode stations [7]. Therefore, situations described allow for the use of GNSS timing at a station level for timing purposes.

A pilot project is being carried out in order to operationally analyse the suitability of Galileo Timing for R-Mode infrastructure under the frame of GSALOT3TRANS-SC10 project. The methodology followed 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 started on January 2021 and the plan is to perform the pilot project and outputs at the end of 2021. This activity is being performed in close coordination with R-Mode Baltic project key partners (specifically WSV and DLR), who have expressed their interests in supporting this pilot.

Three R-Mode stations from WSV will be upgraded to include a Galileo-based timing solution instead of a GPS-only. The R-Mode user receiver equipment within the coverage are of R-Mode transmitting sites will also be upgraded to take also benefit of Galileo. Stations and receiver at “user level” are key modules of the performance analysis of Galileo timing test campaign.

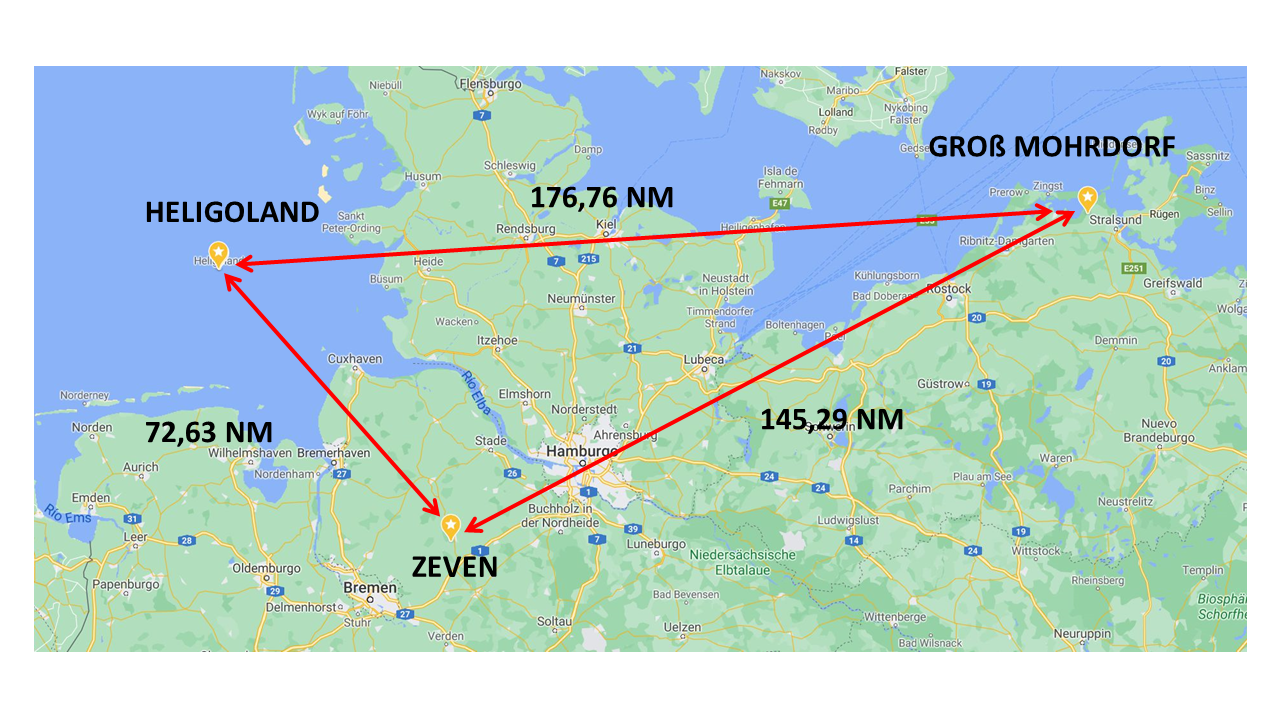


Figure 1‑2 Galileo Timing pilot for R-Mode configuration

The configuration, tests and measurements to be performed will be detailed in a separate PowerPoint presentation to IALA members.

For further information about the project please contact Manuel López Martínez (GSA, <Manuel.LOPEZMARTINEZ@euspa.europa.eu>) or Gema Cueto-Felgueroso (gcueto@gmv.com).

## Purpose of the document

The objective of this paper is to make IALA ENV Committee members aware about the latest status of the GSALOT3TRANS-SC10 project under development by GMV with the support of the German Federal Waterways Administration (WSV) and DLR.

# References

1. Galileo Open Service – Service Definition Document (OS-SDD) Issue 1.1, May 2019
2. ACCSEAS Final Report Review of ACCSEAS Solutions through tests and demonstrations, 13/05/2015
3. 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
4. Feasibility Study of R-Mode using MF DGPS Transmissions Report 11/03/2014
5. R-Mode Baltic - Baseline and Priorities, 11/03/2019
6. Jiang Y, Zheng K. The Single-Shore-Station-Based Position Estimation Method of an Automatic Identification System. Sensors. 2020; 20(6):1590. <https://doi.org/10.3390/s20061590>
7. R0129 (R-129) GNSS Vulnerability and mitigation measures, IALA Recommendation, Edition 3.1., December 2012.

# Action requested of the Committee

The Committee is requested to:

1. Note the information within this paper.
2. Discuss the matter at an appropriate time after the PowerPoint Presentation.
3. Include the proposed information paper into the IALA documentation if so considered by the discussion

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