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Author(s) / Submitter(s) Marta Cueto (GMV), Gema Cueto (GMV), Marcos López (GMV), Philipp Scheidemann (EUSPA).

Advanced Shipborne Galileo Receiver Double Frequency (ASGARD): objective, activities and expected added value

# Summary

ASGARD (Advanced Shipborne Galileo Receiver Double Frequency) project has been launched by the EUSPA with the main objective of developing a multi-constellation (Galileo and GPS) and double frequency (E1/E5, L1/L5) maritime receiver that uses Galileo and complies with the specifications IEC 61108-3 and the international specifications of IMO: MSC 401 (95) & MSC 432 (98). The receiver will also include the implementation of OS-NMA processing capabilities.

This document aims at presenting the project, including its main objectives, activities and expected planning.

For further information about the project please contact Philipp Scheidemann (EUSPA, <Philipp.SCHEIDEMANN@euspa.europa.eu>) and Marcos López (GMV, [malopez@gmv.com](mailto:malopez@gmv.com)).

# Purpose of the document

The objective of this paper is to make IALA ENG Committee members aware about the main objectives of the EUSPA´s ASGARD project currently under development by a GMV led consortium, activities, as well as main added value that the project outcomes are expected to provide to the maritime community and IALA members.

# Introduction to ASGARD project and objectives

**ASGARD Context**

Galileo is the European GNSS, a civil system under civil control, intended to provide navigation services to users and including reliable services for specific user communities. With Galileo satellites working together with other constellations, there are more GNSS satellites available for PNT, and the users are already able to exploit significant improvements in terms of signal robustness and availability, especially in areas with limited chances to receive signals from GNSS satellites. Galileo will additionally provide an Authentication service (in combination with the Open Service) in the navigation message (OS-NMA2), allowing unique data authentication through the signal in space improving GNSS robustness for applications in which safety and security is concerned. Initial OS-NMA Signal-in-Space transmission in test mode were already performed by end of 2020, existing a new test phase starting at July 2021.

OS-NMA is based on 1) the publication of public keys, to be stored in GNSS receivers, allowing the authentication of the Signal In Space E1 I/NAV data through a hybrid symmetric/asymmetric scheme; and on 2) the transmission of data to authenticate the Galileo OS navigation message (e.g. Digital Signatures, Message Authentication Codes and associated Keys) through the E1 I/NAV.

In relation to the maritime domain, authentication and integrity are very relevant aspects for the operations described in IMO resolution A.915, and are differentiators of Galileo with respect to other GNSS. Since Galileo was recognized as part of the world navigation system in 2016 (IMO SN.1/Circ.334), it can be used for merchant shipping as well. IMO also recommended the use of augmentation together with RAIM.

IMO resolution MSC.401(95) and MSC.432 adopted performance standards for multi-system shipborne radionavigation receivers. These resolutions state that the shipborne equipment should use at least two independent GNSS constellations recognised by IMO as part of the World Wide Radionavigation System (WWRNS) and should have the capacity to process augmentation data. This requirement can be fulfilled having a GNSS receiver tracking Galileo and GPS (in dual frequency) and compliant with the corresponding IEC 61108 specifications"

In this context, the ASGARD (*Advanced Shipborne Galileo Receiver Double Frequency*) project has been launched by the EUSPA as a research project (under the Fundamental Elements call targeting shipborne double-frequency receivers) focused on developing a multi-constellation and double frequency (E1/E5) maritime receiver that uses Galileo and that complies with the specifications IEC 61108-3 under the European MED WheelMark, and that at the same time complies with the international specifications of IMO (International Maritime Organization): MSC 401 (95) and MSC 432 (98), including OSNMA capabilities.

**ASGARD Consortium and duration**

With regard to ASGARD consortium, GMV acts as project coordinator, while the technical activities are to be performed by GMV (with proven experience on standardization aspects and on the design, development and integration of positioning algorithms, products, SW and GNSS receivers) and SAAB (one of the most important manufacturers of high performance shipborne navigation receivers). In addition a series of laboratories will provide support in the activities related to verification and validation:

* BSH (Bundesamt für Seeschifffahrt und Hydrographie), a recognized laboratory for maritime navigation and radio equipment testing and approval.
* JRC, the European Commission's science and knowledge service which employs scientists to carry out research in order to provide independent scientific advice and support to EU policy.

ASGARD activities were launched on the first of January 2021 and the project will last 24 months.

**ASGARD Objectives**

Three main objectives define the complete scope of ASGARD project:

* Design, integration and development of DFMC Galileo shipborne receiver.
* Type approval IEC 61108-3, static and dynamic laboratory test campaign in the laboratory following IEC 61108-3 (Galileo) and IEC-61108-1 (GPS).
* Galileo OS-NMA implementation, verifying the authenticity of the Galileo navigation message.

The following section summarizes the main activities identified to achieve the aforementioned objectives, as well as the project plan defined to develop them.

# ASGARD activities and planning

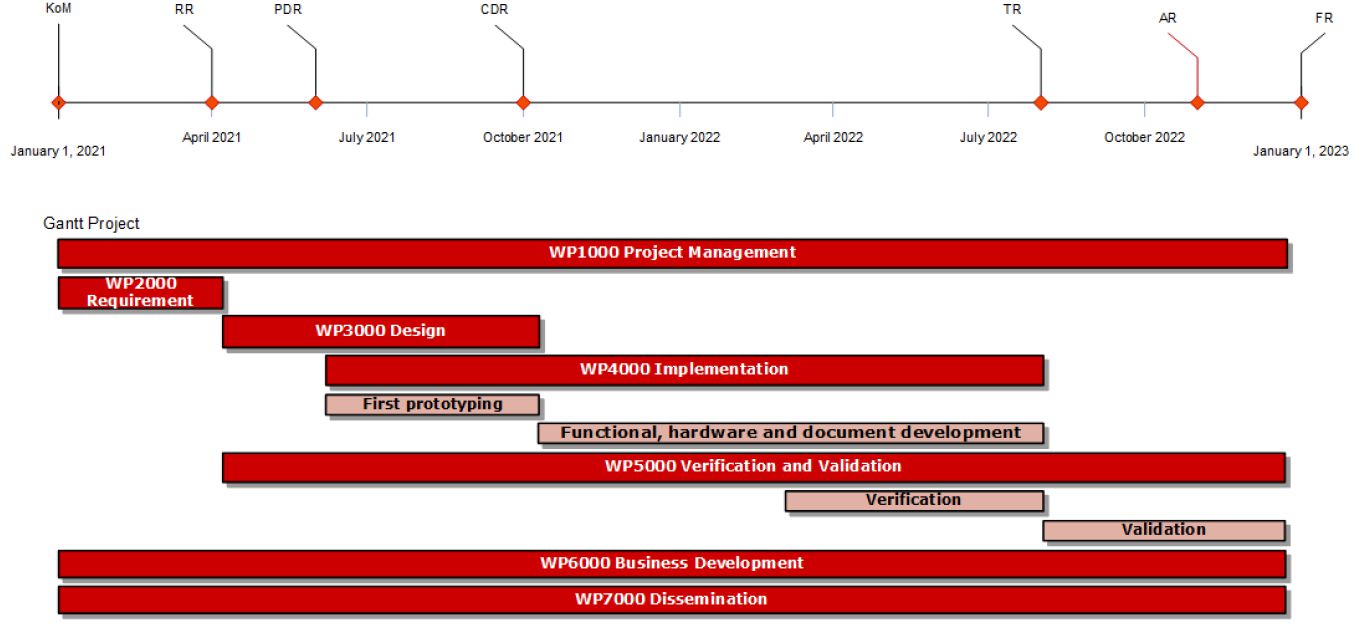
**ASGARD Activities**

Seven Work Packages were identified to cover the activities to be performed to achieve the aforementioned objectives:

* WP1000 (Project Management), covering all management and coordination activities along the project.
* WP2000 (Performance Requirement Analysis and Specification), aimed at:
  + identifying the user needs and the corresponding requirements including requirements justification
  + Defining ASGARD Receiver Requirement Specification, including the definition of overall receiver requirements and specific components requirements (e.g.; receiver board), as well as the definition of an operational concept for the receiver.
* WP3000 (Design), aimed at covering the activities related to ASGARD Receiver Detailed Design Specification, including:
  + Overall receiver preliminary design and interfaces definition.
  + Specific components (e.g.; receiver board) detailed design.
* WP4000 (Implementation), aimed at developing the Prototype Receiver, including:
  + OEM GNSS Receiver Development
  + Shipborne Receiver Integration and Documentation
* WP5000 (Verification and Validation), aimed at performing the ASGARD receiver Verification & Certification activities, including:
  + Modular functional testing and Preliminary IEC key tests, for the Verification phase
  + Testing with simulated data at Laboratory level following IEC tests, testing with real data on board a vessel and testing simulating spoofing attack, for the Validation phase.
* WP6000 (Business Development), aimed at developing the Business Case, including the Identification of the benefits linked to ASGARD receiver with IEC 61108-3 and OS-NMA capabilities, Economic analyses for the market penetration, Business plan consolidation, consolidation of plan for future upgrade after ASGARD project and future promotion activities after ASGARD project, as well as Industrial Property Rights.
* WP7000 (Dissemination), aimed at gathering the project activities related to dissemination of the ASGARD outcomes.

**ASGARD Planning**

The aforementioned activities are planned to be developed during the 24 months of the Project duration following the Schedule provided in the following figure:



# expected added value of project outcomes

It is expected that ASGARD project will fulfil its requirements of developing a new multi constellation, double frequency and OS-NMA processing capable maritime navigation equipment, following the current international maritime regulations and standards, such as IMO 122, IMO 233 and IEC 61108-1, IEC 61108-3, as well as other new regulations (still without IEC test) such as IMO MSC.401/432.

It is also important to point out that, despite not specifically included in any current maritime regulation, ASGARD new equipment will include the implementation of OS-NMA processing capabilities, which could be key for specific use cases where authentication is expected to provide an important added value.

# References

1. TBC

# Action requested to the Committee

The Committee is requested to:

1. Note the information within this paper.
2. Discuss the matter at an appropriate time and
3. Include the proposed 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)