**Input paper: [[1]](#footnote-1)** ARM14-3.2.11

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

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analysis of GNSS user requirements for buoys and added value from galileo and sbas

# Introduction

GNSS-enabled buoys, which have been classified into scientific buoys and those linked to fishing aggregating devices, have different purposes depending on their main end-users, purpose, and function. While smart fishing buoys are used to detect fish banks, such as tuna, ocean monitoring buoys are be used for various purposes ranging from climate change research, water quality monitoring, metocean studies and many others.

The current installed base of GNSS-enabled buoys seems to be practically based on GPS-only chipsets. Thanks to the appearance of multiple navigation satellite systems, multi-constellation receivers are becoming widely available so it is reasonable to assess whether these type or receivers may be of interest for GNSS-enabled buoys.

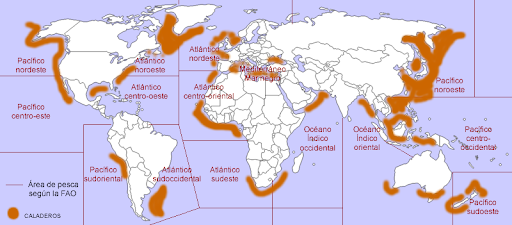
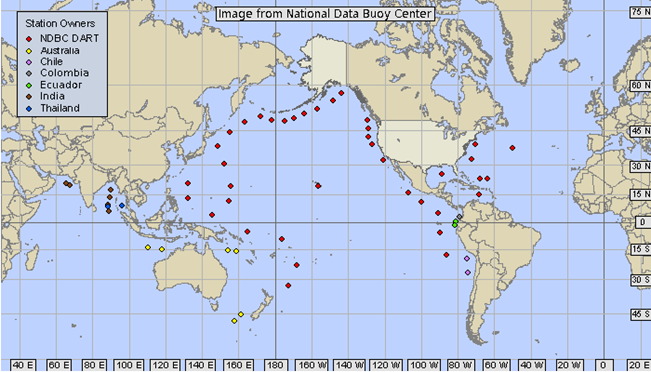
 

Figure 1‑1. Main Location of Fishing Activities

Figure 1‑2. Location of Tsunami detection buoys

# GNSS user requirements

Based on available literature as well as consultation with some of the major manufacturers of both ocean monitoring buoys as well as fishing buoys, the following GNSS performance requirements were identified, respectively for ocean monitoring buoys as well as for fishing aggregating devices.

**Accuracy (positioning)**

* Certain applications for scientific buoys in rivers or harbours may benefit from high accuracy GNSS (i.e. 10m (95%) or less, but there is not a general demand of high accuracy horizontal performance neither for scientific buoys applications (stakeholders indicated that a stand-alone GNSS and single constellations currently meet requirements) nor for fishing aggregating devices (stakeholders indicated that a stand-alone GNSS and single constellations currently meet requirements). GNSS positioning is used mainly to locate the area a certain buoy is in to get close enough to spot it visually or to locate the scientific data logged by other sensors. Therefore single-constellation and GPS-only systems are enough to fulfil this objective.
* When it comes to the need for vertical accuracy, it can be noted that a research project has been launched to investigate the use of high-precision RTK GNSS sensors on buoys deployed on rivers and inland waterways. This type of buoy application could support the improvement of inland waterway navigation by providing accurate information (i.e. 10 cm or less) on water depth and vertical bridge clearance.
* Galileo HAS, which would be able to provide a horizontal accuracy of 20cm and a vertical accuracy of 40cm, or any other PPP-based solution could reduce the cost of the dual systems used nowadays (seabed tsunameter and floating buoy for external communication) to measure wave height but the actual role of the GNSS receiver in these height estimations has to be more precisely detailed in order to assess its feasibility.

**Accuracy (Timing and synchronization)**

* There is the need of introducing timing features in specific areas like for example when a net of buoys is used to detect the propagation of waves or for synchronization of lanterns which may indicate designed paths of entry to ports. Besides, the level of precision provided by GNSS for timing is more than enough than the required value of a tenths of seconds.

**Availability**

* Looking at the applications where buoys will be used and extracting from interviews the necessity of measures few times a day, the availability becomes a minor issue in terms of GNSS performance. IMO Resolution A.1046(27) requirements of at least 99.8%, already fulfilled by most GNSS systems would then be valid.

**Continuity**

* Being the continuity directly related to the availability of GNSS and following what was stated for the availability, not huge levels of continuity are required for the applications studied in scientific and fishing buoys. IMO Resolution A.1046(27) requirements of at least 99.97%, already fulfilled by most GNSS systems, would then be valid.

**Integrity**

* Just one of the interviewed companies showed interest in the integrity inclusion on the buoys in order to have a position stamp with legal implications. Therefore, in this case SBAS was seen as a good candidate not only because of the integrity provided, but also by its level of reliability. Even though, the power consumption and the time for which the receivers remain connected may have a negative impact increasing the battery consumption, also for integrity algorithms like RAIM or ARAIM. A careful trade-off between benefits and costs should be analysed; however, it seems that integrity is not widely required by users and the costs may not compensate the benefits for these users.

**Authentication**

* It is concluded that the use of authentication mechanisms like the one that will be provided by Galileo in the coming years (OS-NMA) is not required due to the lack of threats in the environment of application of the buoys, which could highly affect the GNSS solution. In addition, the increased battery consumption as well as the necessity of a reliable timing source which will make it more expensive may not be accepted by the users.

**Initialization time (TTFF)**

* The initialization time (TTFF) may affect the total time that the receiver must be on in order to converge to the proper GNSS solution. This duration directly affects the battery consumption, which as it was showed before, results in a critical element of the buoys. Therefore, the introduction of a constellation which may reduce the TTFF, as Galileo may do, was of interest for the interviewed companies.

**Coverage**

* The satellite orbit inclination of Galileo helps to increase the coverage of the European system, thanks to reaching latitudes closer to the poles. Therefore, more satellites are visible at those locations which reduces the TTFF and improves the accuracy which may be of interest for many applications.

For further information about the project please contact Manuel López Martínez (GSA, <Manuel.LOPEZMARTINEZ@euspa.europa.eu>) or Karel Callewaert (VVA, <k.callewaert@vva.it>) or Gema Cueto-Felgueroso (GMV, gcueto@gmv.com).

# Purpose of the document

# This paper serves the purpose to inform the IALA ARM Committee Members about the identification of user requirements for ocean monitoring and fishing buoys, studied under the Framework Contract GSA/OP/09/16/Lot 3 that focused on the adoption of EGNSS differentiators in Transport and Emergency response applications, prepared by VVA and GMV for EUSPA.

# References

1. 2008 Federal Radionavigation Plan, American Department of Defense, Department of Homeland Security, and Department of Transportation
2. Resolution A.915(22): Revised Maritime Policy and Requirements for a Future GNSS, IMO
3. Performance and Monitoring of DGNSS Services in the Frequency Band 283.5-325khz, IALA
4. The State of World Fisheries and Aquaculture 2020, FAO

# Action requested of the Committee

The Committee is requested to:

1. Note the information within this paper.
2. 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)