

GLA marine radiobeacon DGPS - article

Introduction

The General Lighthouse Authorities of the UK and Ireland (GLA)¹ provide differential GPS (DGPS) to users within their waters as part of the mix of marine aids-to-navigation (AtoN) provided to keep mariners safe and to protect the environment.

The GLA DGPS system was first introduced in 1995 as a trial system, being formally declared operation in 1997. The system consists of 14 DGPS reference stations (as shown in Figure 1), 6 far-field monitoring sites and 3 monitoring and control sites. The system is operated as a single AtoN, albeit one operated and maintained by three authorities.

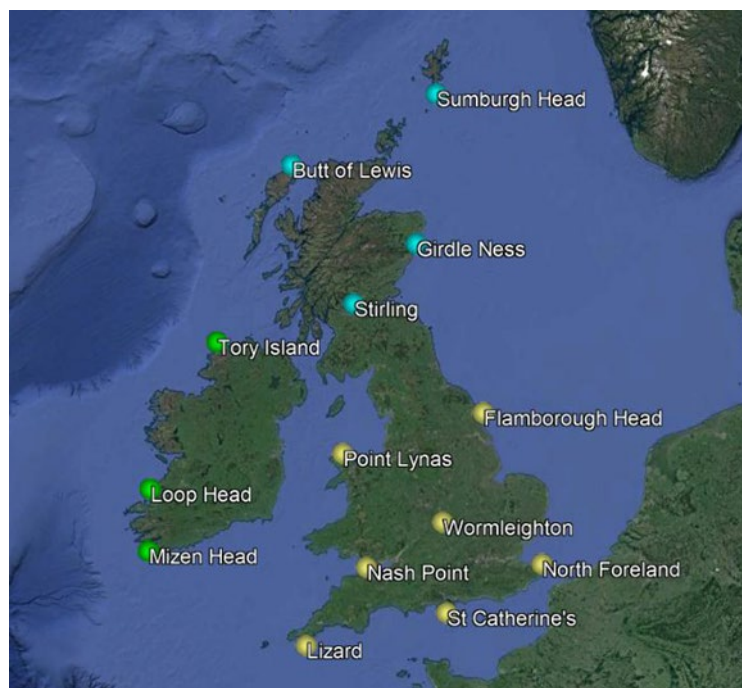


Figure 1: Location of the 14 GLA DGPS reference stations

History

Marine radiobeacon DGPS was developed to counter Selective Availability (SA), a deliberate error added to the civilian GPS service to degrade the positional accuracy. SA caused the reported position to wander even when the user was static, something that's clearly not ideal when trying to navigate a vessel.

By comparing, the estimated GPS position reported of a receiver sited at a precisely known location, it is possible to calculate the amount of position error at any given time. The error in the position calculation is caused by many different factors, not just SA. Errors for each satellite are identified and a correction for each is provided to mariners operating nearby, via the 300 kHz broadcast. Maritime receivers in the region can apply such corrections and improve the estimated reported position. At the time of SA, this meant an improvement from approximately 50m to around 5m².

¹ GLA comprises of The Commissioners of Irish lights, The Northern Lighthouse Board and Trinity House.

² <https://www.gps.gov/systems/gps/modernization/sa/data/>

In addition to improving the estimated position accuracy, by assessing whether the error is within a given threshold, the reference station is able to monitor the performance of the GPS constellation and identify any faults. Faulty satellites are removed from the position solution, therefore providing position integrity for the mariner.

SA was discontinued in 2000 and GPS offers the civilian user a position accurate to around 3-5m today³. DGPS continues to improve the positional accuracy, albeit with a smaller improvement, enabling positions in the region of 1-2m today. The integrity element remains unchanged and is often cited as the main benefit of DGPS in a post SA world.

GLA stakeholder consultation

The GLA service was partially replaced around a decade ago. Subsequently, the current infrastructure is approaching the end of its design life and the GLA conducted a stakeholder consultation to assess the requirements for the service going forward.

The consultation process sought input from stakeholders across the maritime sector, and beyond, through direct engagement and via a widely circulated user survey. GLA personnel interviewed vessel crews from across the UK and Ireland, and 153 people responded to the survey. Figure 2 provides an overview of the different respondent groups along with their percentage of total responses.

It can be seen that the vast majority of responses were from mariners and maritime operators (e.g. engineer, scientific officer, operations manager, harbour master etc.). Such responses presented mariners operating a wide range of vessels including ferries, container ships, tankers, liquid natural gas carriers, bulk carriers and leisure craft.

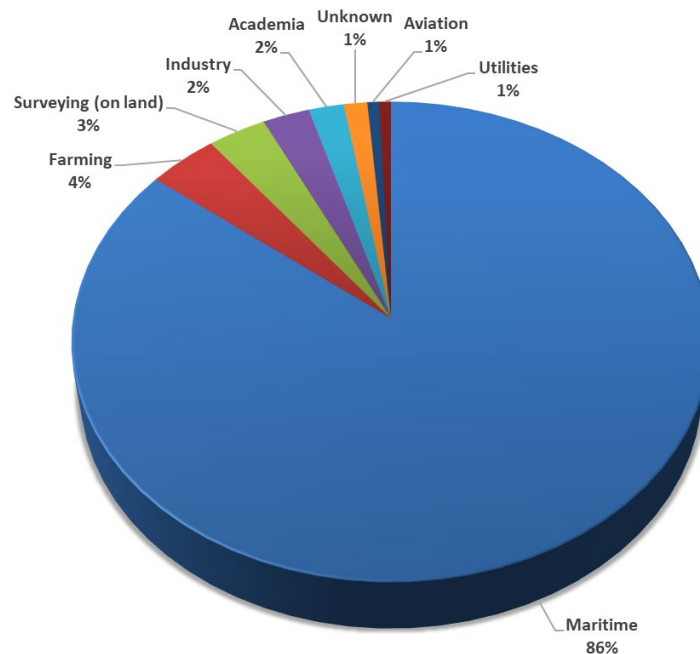


Figure 2: Percentage of survey responses received from different stakeholders and potential users

³ Noting that the GPS standard positioning service accuracy is reported as <7m, ref GPS SPS, 2020

The survey resulted in a mix of responses, with the majority of mariners reporting that they use the GLA DGPS system for accuracy improvements and integrity, as one may expect, while others reported that they do not use it.

Mariners were asked which GNSS constellations they used today and those they expected to use in the future. All mariners reported using GPS today with around 40% also making use of GLONASS, and around 9% using Galileo too. From the response received, it is expected that more mariners will move to multi-constellation receivers, making use of GPS, GLONASS, Galileo and BeiDou, over the next 5-10 years.

Face-to-face discussions concluded a similar mix of views; while the majority considered the GLA DGPS system a useful service, others reported that it wasn't used. It was noted that DGPS works quietly in the background and therefore can be inconspicuous on the bridge until it is unable to work correctly at which point an alarm is raised to inform the bridge crew.

Maritime equipment

While marine radiobeacon DGPS is not mandated by the International Maritime Organization (IMO) for carriage on SOLAS vessels⁴, it is provided for in all maritime receiver standards and the spectrum is allocated internationally. Marine radiobeacon DGPS is a common method for receiving differential correction information at sea on many classes of vessel.

Following a change in maritime receiver standards in 2003, all receivers now include Receiver Autonomous Integrity Monitoring (RAIM). RAIM is a means of determining whether the resulting position estimate is safe to use through an algorithm within the receiver. As the name suggests it's another means of determining integrity, i.e. whether the position solution is safe to use.

Differential corrections are also available from other sources, including Satellite Based Augmentation Systems (SBAS), which are primarily provided for aviation users. Work is under way in Europe to introduce a maritime service to EGNOS⁵, the European SBAS. This service is expected to be available around 2022. It is important to note that today's maritime receivers are not tested for how they apply SBAS data as that functionality is not part of the receiver standards today. This is being addressed and those mariners wishing to take advantage of SBAS information in the future would need to upgrade their receiver to one that is type approved for SBAS use (expected 2022-23).

Future of the GLA DGPS network

After careful consideration of the results of the consultation process, recognising that today's GNSS are able to meet all but the most stringent accuracy requirements, and that position integrity can be provided by alternative means (RAIM or by mariner's validating their position via other visual and electronic aids-to-navigation), the GLA have concluded that their DGPS system is now redundant.

The GLA recognise the need to provide adequate notice and support continuity of service going forward. As such, the GLA DGPS system will remain operational until 31st March 2022, at which point the signals will cease.

It is recognised that while SBAS, such as EGNOS across Europe, should provide useful services to the mariner in time, there is no guarantee that they will come to fruition. Similarly, it is anticipated that alternative sources of integrity will continue to improve as mariners move to multiple satellite

⁴ Those vessels covered by the IMO Safety of Life at Sea convention

⁵ European Geostationary Navigation Overlay Service

constellation receivers, with more satellites and signals available, and as RAIM algorithms advance. The use of all available satellite constellations with advanced RAIM algorithms in the future is expected to provide greater positional accuracy and integrity than is available today with marine radiobeacon DGPS.

Guidance to mariners

The GLA advise mariners to consider their use of DGPS and to plan for its discontinuance accordingly. Mariners should check their GNSS receiver(s) to confirm the presence of RAIM and consider upgrading to type approved SBAS receiving equipment when available. Overall, the GLA encourages mariners to use all available AtoN, whether visual or electronic to support their safe passage and the protection of the environment.

Contact point

If you have any questions or comments please feel free to contact:

Dr Alan Grant, GLA DGPS System Director – alan.grant@gla-rad.org