 Input paper: [[1]](#footnote-1) ENG2-10.11

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

**□** ARM **✓** ENG **□** PAP **✓** Input

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

Agenda item [[2]](#footnote-2) 10

~~Technical Domain~~ / Task Number 2 …2.1.2………………………………

Author(s) / Submitter(s) …Peter Dobson………………………………

Implementation of e-Navigation system -

Problems of mounting AIS AtoN aerial systems on buoy

# Summary

This paper outlines the experienced Trinity House has had in fitting AIS AtoN on Type 1 monitored buoys. In particular, it identifies the challenges of adding additional antennas to a buoy, the problems that have been encountered and the developments to overcome them.

## Purpose of the document

This is an information paper responding to the committee’s requirement to understand the challenges in adapting buoys to adopt AIS as part of an e-Navigation implementation.

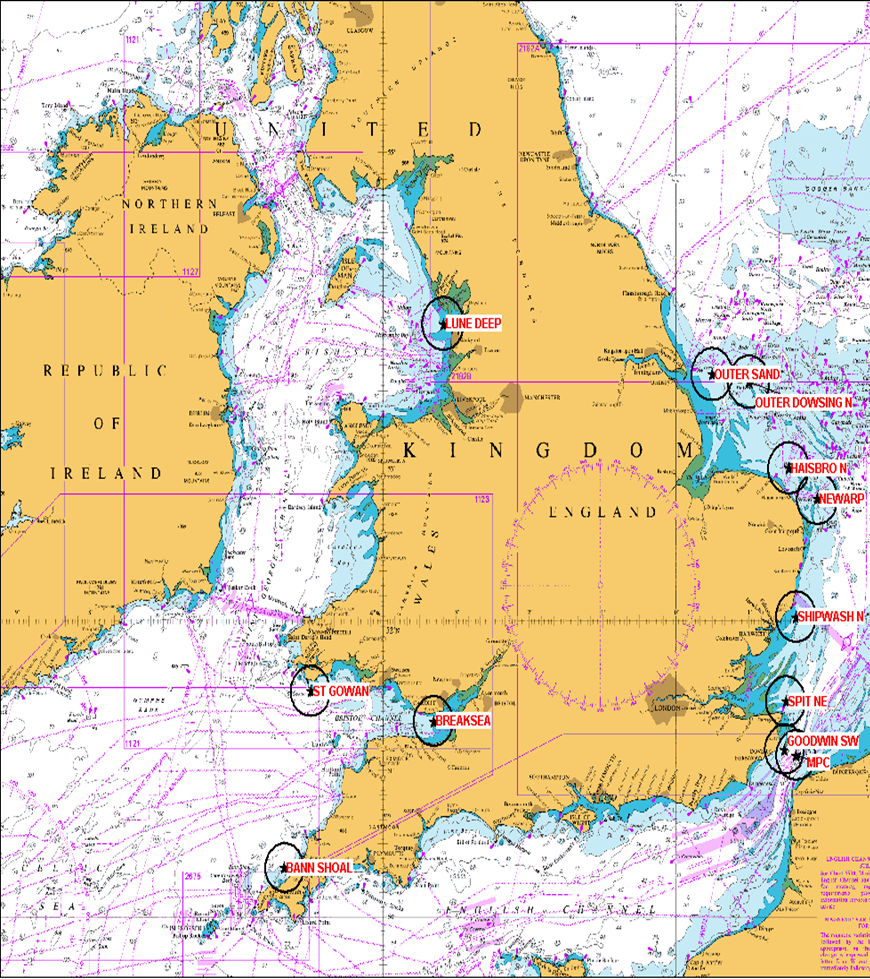
# Background

Following work done by Task Group 2 at ENG1, it was requested that Trinity House provide some background to problems or challenges encountered when implanting e-Navigation systems, in particular the problem of fitting AIS antennas onto buoys.

# AIS application to a type 1 monitored buoy

## Background

Trinity House first started fitting AIS AtoN’s to its Type 1 buoy in 2013, with it only being deployed to small population of important buoys. Some 12 station as shown in Figure 1 - Location of buoys fitted with AIS AtoN.



1. Figure Location of buoys fitted with AIS AtoNs

## Type 1 Monitored Buoys

Prior to AIS AtoN being installed, each buoy already had a monitoring system that provided buoy status and position feedback to the monitoring centre in Harwich. This was achieved using a commercially available VHF radio link called Paknet, provided by Vodafone. As such the buoy had a number of antennas fitted, even before considering adding AIS. A view of the top of the buoy is shown in Figure 2 - Type 1 monitored buoy without AIS fitted.

## S:\HASHARED\PhotoStore\Buoys\Class 1\Sunk\Sunk Acceptance Inspection March 08 PPD\IMG_1283.JPG

Paknet VHF antenna

GPS antenna

1. Type 1 monitored buoy without AIS fitted

## Fitting AIS and the Challenges

With the application of AIS AtoN on the Type 1 monitored buoys came the challenge of, “what needs to be fitted at the top”. Some of these had already been overcome, with the light and Racon having a clear view to the horizon, the topmark being at the very top and the VHF antenna and GPS antennas being marginally compromised by the topmark. Now however, there was the need to fit a second VHF and an AIS unit with an inbuilt GPS receiver, both of which want to be at the top of the buoy and clear of obstructions. Clearly, some level of compromise was going to occur.

Over and above the issue of “what needs to be at the top”, was some concern over the use of two VHF antennas in close proximity. The best compromise was to fit both antennas as high as possible and with a reasonable separation, both to one another, but also to the steel topmark pole.

The location of the AIS unit, with its built in GPS antenna is probably the item that is most compromised, when compared against an ideal locations. The unit had been located around the level that the light is fitted, leading to a GPS radio frequency shadow created by both the topmark, antennas, radar reflector and the superstructure that support all this. The AIS unit however, is not centred and therefore the RF shadow only affects an arc of coverage. Additionally, what also offsets this compromised position is the sensitivity of modern GPS receivers and as such this position has not been problematic for us.

|  |  |
| --- | --- |
| AIS Unit  AIS Antenna  GPS  Antenna  Paknet  Antenna   1. A full complement of antennas | C:\Users\peterpd\Dropbox\IALA\AIS fitting\DSCF4844.JPG   1. Reality |

There were two other areas that fitting AIS to a buoy had an impact on, these being the power systems and the monitoring system. In the case of the power system, the buoy had sufficient battery and solar capacity to accommodate the fitting of AIS and spare power connectivity was already in place.

To be able to transmit AtoN status on message 21 required repeating the existing monitored status from the telemetry system to the AIS system. A small modification to the monitoring box to allowed for suitable opto isolated signals to be available.



1. Figure 1 - Telemetry Unit

## Problems Encountered

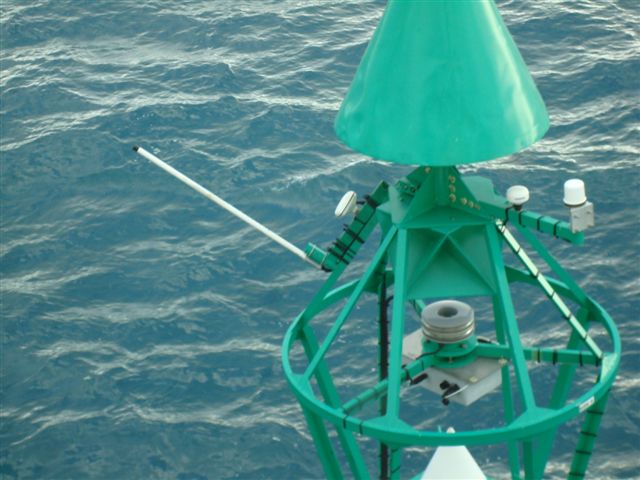
The most significant problem encountered due to the fitting of AIS on a buoy, has been associated the antenna location. It is not the radio transmission that is a problem, but the delicacy of the arrangement of antenna when deploying.

The lifting arrangement on both of the buoy support tenders require two steel wires to pass alongside the superstructure to pickup lifting points on the buoy body. See Figure 6



1. Type 1 buoy being lifted

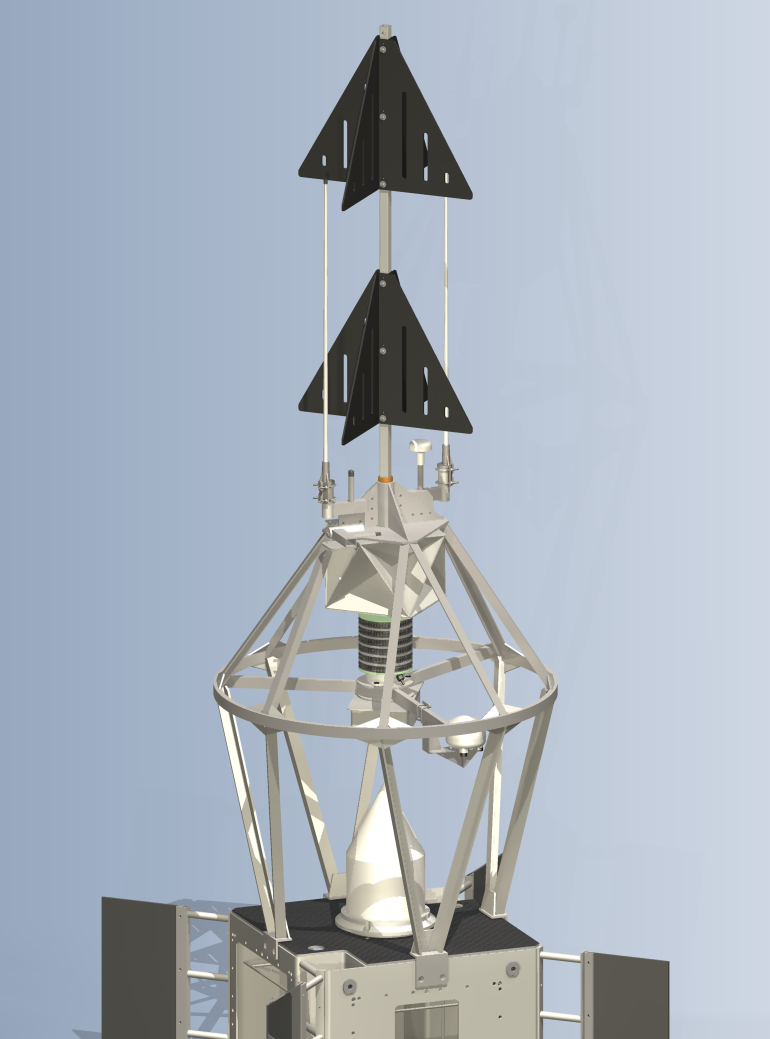
For one of the Tenders this is exasperated further as the top of the buoy to pass between the lifting forks. The outcome of this is the susceptibility to damaging the antennas and a restriction to the range of weather condition as to when these buoys can be serviced and deployed.



1. Damaged at deployment

## Improvements

To improve the robustness of the antenna location and expand the condition when the buoys can be lifted, an alternative topmark design is being trialled. The goal of the topmark is to allow the VHF antenna to be moved inboard such that the ring on the topmark supports, provides physical protection from the wires and that the buoy would need to swing a significant amount before the antennas are damaged by the lifting forks. An example of this new topmark arrangement is shown in Figure 8 New topmark and antenna arrangement



1. New topmark and antenna arrangement

This new topmark is made from a GRP pole and Polyethylene vanes, such that it has a minimal impact on the RF performance of the antennas. This design eliminated the concerns regarding the impact the steel topmark pole would have on the radio signals strength, but concerns then fell on what effect having two similar frequency antennas closer together would have. To identify what impact this would be, a simple test was done where one antenna radiated a fixed signal as the buoy was rotated. Measurements of the received signal strength were taken and these results are shown in Table 1 - Polar plot of radiated signal strength

1. Polar plot of radiated signal strength

|  |  |  |
| --- | --- | --- |
| Start position (0 Deg.) | -65 dBm |  |
| -45 Deg | -65.5 dBm |
| -90 Deg | -67 dBm |
| -135 Deg | -69 dBm |
| -180 deg | -67.6 dBm |
| -225 Deg | -65.5 dBm |
| -270 Deg | -66.5 dBm |
| -315 Deg | -65 dBm |

This arrangement of new topmark and antennas is due to be deployed a little later this year on a number of buoys, where it is hoped the anticipated benefits are realised.

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